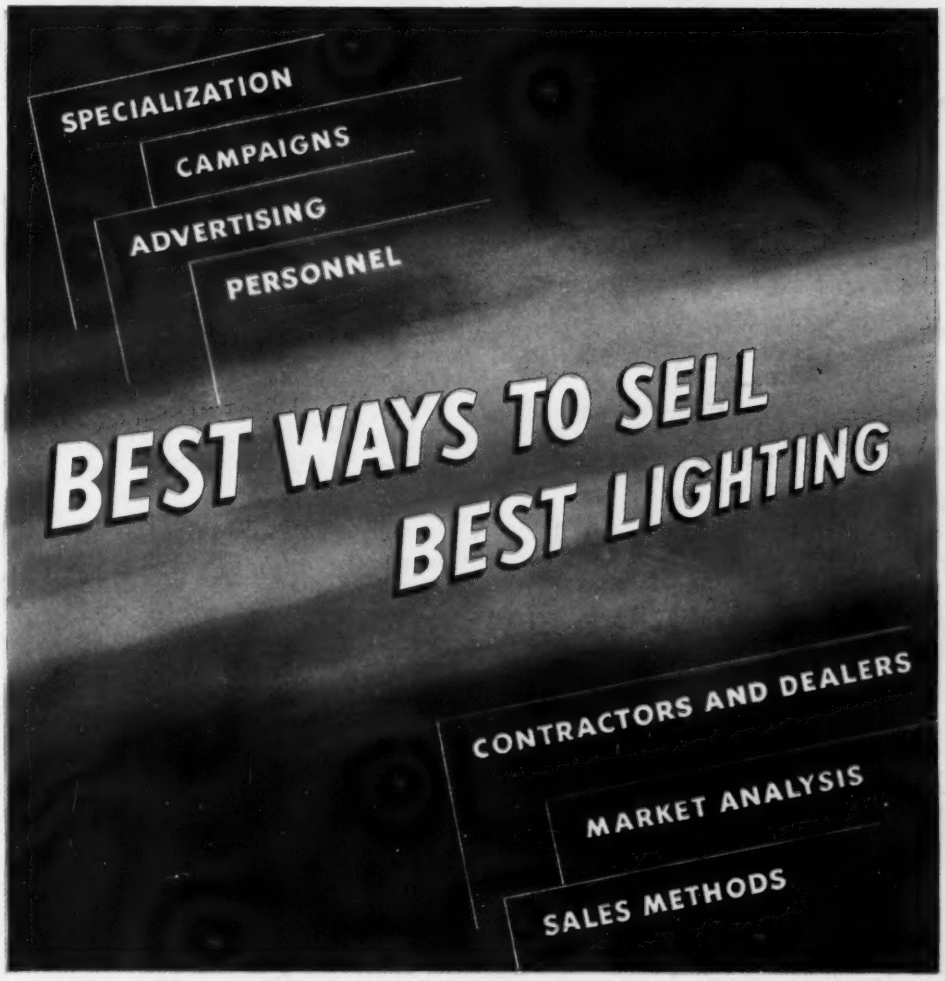
Electrical World



SEPTEMBER 28, 1946

Selecting Supervisory Control • Drying A Furnace Transformer

Problems In Ventilating Power Stations

Pumped Storage Firms Hydro Capacity

A McGRAW-HILL PUBLICATION

Murray Crows'nest

MADE ESPECIALLY for HARD-TO-REACH UP-IN-THE-AIR

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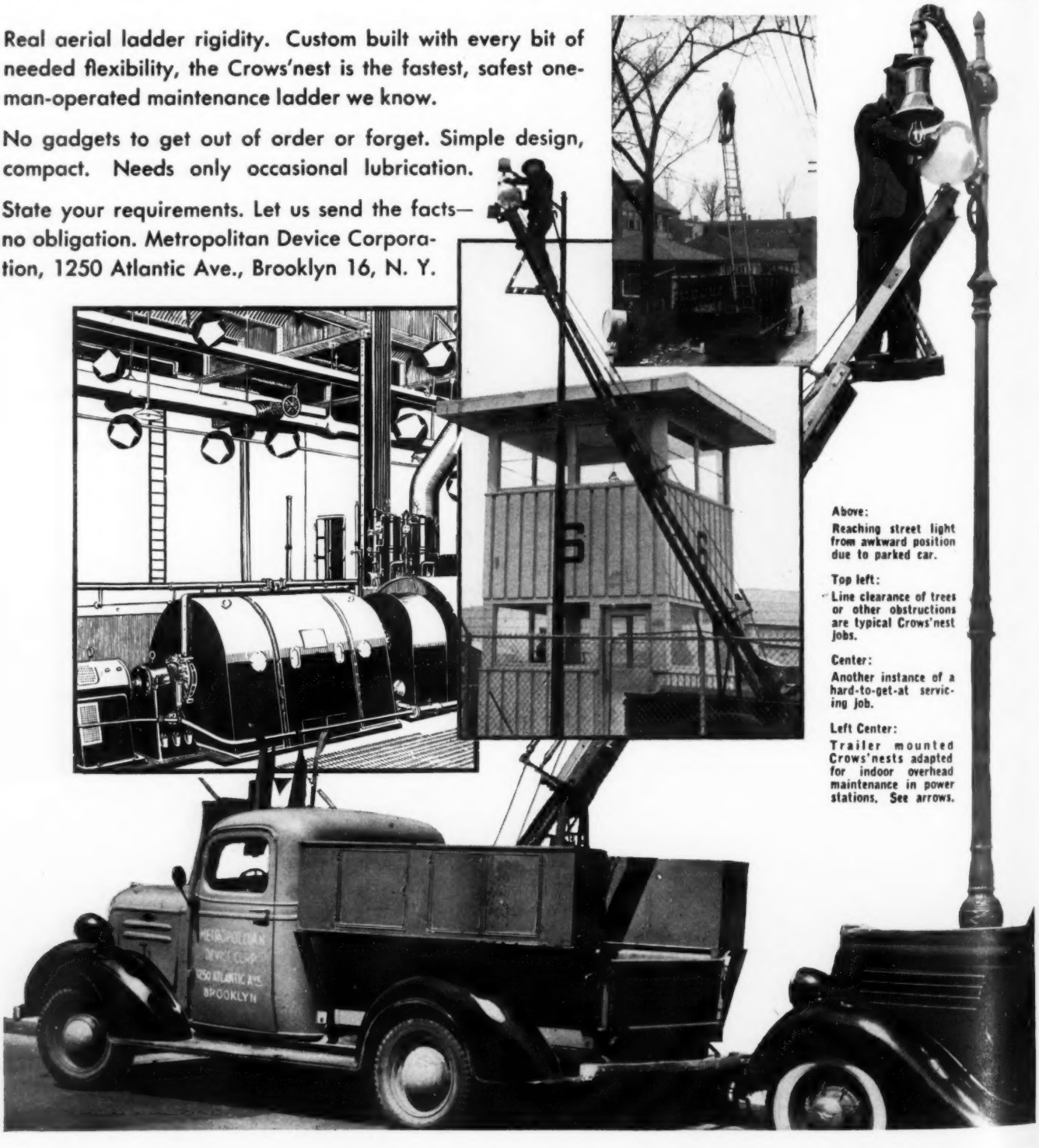
No gadgets to get out of order or forget. Simple design, compact. Needs only occasional lubrication.

State your requirements. Let us send the facts—no obligation. Metropolitan Device Corporation, 1250 Atlantic Ave., Brooklyn 16, N. Y.



Above:
Reaching street light from awkward position due to parked car.

Top left:
Line clearance of trees or other obstructions are typical Crows'nest jobs.

Center:
Another instance of a hard-to-get-at servicing job.

Left Center:
Trailer mounted Crows'nests adapted for indoor overhead maintenance in power stations. See arrows.

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Something to Think About

At a time not very far ahead, the electric utility industry will have to act, widely and positively, in the character of what it is supposed to be, a business of private enterprise offering earnings as the reward of risk investment. If it does not so act, there is more than a little probability that it will be pushed much farther along towards extinction as that kind of business.

Here are some figures that should be looked at, not shied away from, even though the point they make rests in part on a comparison with the now-so-fashionably-abhorred days of the 'twenties.

In the period 1924-1945 inclusive, according to Electrical World statistics, the electric utilities laid out $11,401 million in capital construction, $6,447 million of new money came into the business, and generating capacity rose from 20 million to 50 million kilowatts. Per kilowatt, the added capacity, system-wise, cost $380, of which $215 or 56 percent was new money, the remaining $165 coming from depreciation and surplus.

Now we divide the 22 years, 1924-1945, into two periods, before and after the New Deal took over, and look at the figures.

In the years 1924-1933 inclusive, the industry expanded from 20 million to 34 million kilowatts, expended $6,511 million for construction, and took in $5,783 million of new money. Per kilowatt, that was $465 expended, of which $413 was new money, 89 percent.

Then in the time 1934-1945 inclusive, expansion was from 34 million to 50 million kilowatts, capital expenditures were $4,889 million, and new money $664 million. Per kilowatt that was $306 expended and $42 of new money, 14 percent.

Here are three proportions of new money in capital construction, 14 percent over a period of 12 years; 89 percent, 10 years; 56 percent, 22 years.

It has been estimated that the electric utilities must expand 30 percent by 1950 to meet demands on them, must grow to 65 million kilowatts capacity. That, from 1945, is a rate of 3 million kilowatts per year, more than double the average rate of expansion of the previous 22 years.

That accelerated expansion to the tune of at least $6 billion certainly will not be financed by funds in which the proportion of new money is anything like the 89 percent of the 'twenties.

Can it be financed with new money contributing only around the 14 percent of the past twelve years?

Won't the intake of new money have to increase, perhaps have to approach the 22-year ratio of 56 percent?

To bring in new money in ratio even distantly approaching 56 percent of the cost of the estimated five-year capital construction, the electric utility industry will have to make itself much more attractive to risk investment than it is now. That can be done only by paying out earnings or by giving pretty firm promise to do so fairly soon.

If new money does not come into the business in sufficient quantity, the expansion foreseen as necessary in the next five years or so will not be accomplished. If the expansion is not accomplished, private enterprise will have failed to supply the service the people want. What better argument could be handed to the government ownership advocates? That is something to think about.

Add Firm HYDRO CAPACITY With Pump-Storage Plan

Plan to pump flood-flow of Wisconsin River into storage reservoir for later release will increase firm hydro capacity of existing plants on the lower river 37 percent. Project to cost $2,750,000

C. E. KOHLHEPP* and VINCENT A. THIEMANN,† *Wisconsin Public Service Corp., Milwaukee, Wis.*

EXISTENCE of a privately financed valley improvement enterprise that has operated successfully in Wisconsin for the past 38 years was unknown until recently to many people outside the state who have come to associate valley development with the functions of government.

The revelation came when the Wisconsin Valley Improvement Co. announced this spring that it would build a $2,750,000 pumped-storage reservoir on a tributary of the Wisconsin River near Wausau. To be known as the George Mead reservoir, it will store 430,400-acre-feet of water of which 75 percent will be pumped from the Wisconsin River during flood, up 25 ft. into the reservoir for later release through eleven existing downstream hydro plants to produce an additional 50,000,000 kw.-hr. of energy at a unit cost of about 4 mills. Used in this manner the reservoir will increase firm hydro generating capacity of the eleven plants on the lower Wisconsin River 37 percent.

Mead reservoir when finished will be the 22nd and largest of the water storage reservoirs in the system of the Wisconsin Valley Improvement Co. Although no power is developed at any of the reservoir dams themselves the water accumulated during flood in these pools is released during low-flow through the hydro plants of paper companies and electric utilities along the river. These companies that benefit from the stored water pay toll for its use and are also the principal stockholders of the Improvement Co.

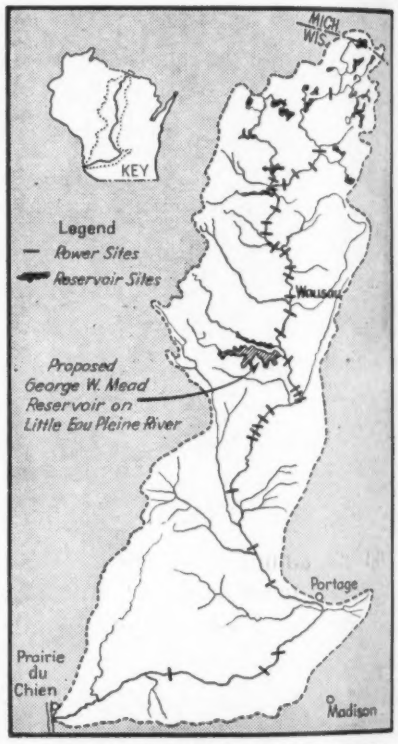
In addition to regulating river flow for power purposes these reservoirs, which were developed by private capital, also reduce floods, augment low river discharge and so minimize pollution from wastes, improve sanitation, conserve fish life and develop the river for recreation. Thus the public benefits from the reservoirs but pays no part of the cost. Taxes last year took 31 percent of the reservoir tolls.

Drainage area of the Wisconsin River, locations of reservoirs and water power sites are shown on the accompanying map. Tables I and II list the reservoirs and power sites and explain the locations on the map.

Potential Capacity

The Wisconsin River has a fall of 1,000 ft. from the source to mouth of which 580 ft. has been developed to provide 101,682 kw. of electrical capacity and an additional 35,350 hp. of mechanical capacity. Of these developed sites, 243 ft. of head is represented in eleven plants on the lower river, below the proposed Mead reservoir, having an aggregate electrical capacity of 56,680 kw. (and 32,050 hp. additional mechanical capacity). There remain at present four additional undeveloped power sites on the lower river with an aggregate head of 102 ft.

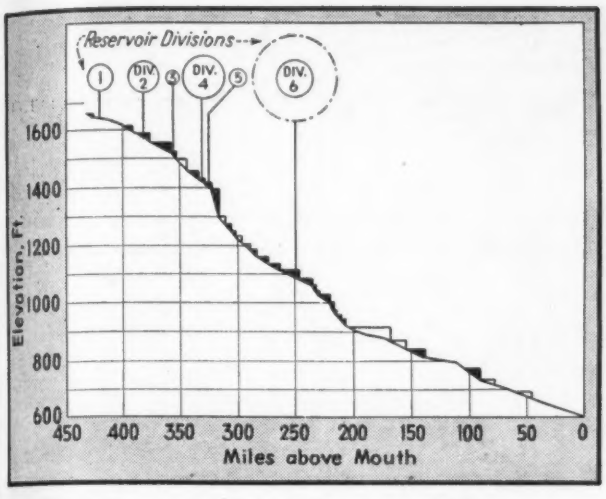
Firming of the capacity of these developments on the lower river is the objective sought in the construction of the Mead reservoir. Flow-duration curves for the Wisconsin River at Nekoosa, shown, indicate that the George Mead reservoir will increase river flow about 700 cfs. for 60 percent of the time or 220 days a year. This amounts to an average yearly benefit from the reservoir of 311,000 acre-feet or 77.8 percent of its effective storage capacity of 400,000 acre-feet. (Effective capacity allows for the quantity of water impounded as ice that cannot be released each year before the spring break-up and will be carried over in the reservoir from year to year.) Water from the reservoir will also increase minimum river flow at Nekoosa by 700 cfs. or from 1,900 cfs. to 2,600 cfs.



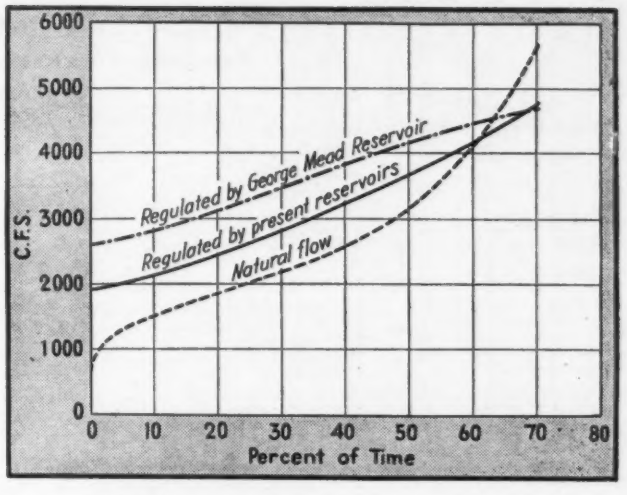
RESERVOIRS AND POWER SITES —Flood waters of the Wisconsin River pumped into the proposed George Mead reservoir for subsequent release will increase generation of downstream plants 50,000,000 kw.-hr. annually and add 10,000 kw. to firm capacity. Both developed and undeveloped sites are shown along the river

Situations prevailing at the various plants as to efficiency, load factor, peaking capacity, and cost of alter-

* Vice-President and Gen. Mgr.
† Asst. Chief Engineer



WISCONSIN RIVER PROFILE—Relationship of reservoirs to existing and undeveloped power sites. Circle area corresponds to division storage capacity. Dotted circle for division six includes Mead reservoir



FLOW DURATION CURVES—Release of water from Mead reservoir will increase river flow 700 cfs. about 60 percent of the time and increase minimum flow from 1,900 cfs. to 2,600 cfs. Gage readings are at Nekoosa

nate power sources are such that the economic benefits of the Mead reservoir can only be evaluated in general terms. Two stations on the lower river lack enough water wheel capacity to use the additional river flow from the reservoir, so toll head will be about 218 ft. instead of 243 ft. Average storage release of 311,.000 acre-feet will generate about 50,000,-000 kw.-hr. in this 218 feet of toll head at 70 percent efficiency. The 700 cfs. additional to the low river flow will increase firm capacity an estimated 10,000 kw. at 100 percent load factor. Unit cost of the water released from the reservoir, based on the above assumptions, is about 4 mills per kw.-hr.

Tolls Diluted

As more sites are developed on the lower river, toll charges will be spread over more head and the cost per kw.-hr. will be reduced. Estimates indicate that development of the four potential sites—boosting aggregate head to 320 ft.—will permit increasing generation from 50,000,000 to 78,000,000 kw.-hr. at 85 percent efficiency for undeveloped sites. Installation of more efficient water wheels in the older hydro stations raising their efficiency to 85 percent and increasing capacity in the two plants now having inadequate wheel capacity will permit realizing the full potential head of the lower river and increase the additional generation to 94,000,-000 kw.-hr. annually.

Desirability of increasing flow on the lower river by building a reservoir on the Little Eau Pleine River has been established for some time. Until recently such a scheme bogged down over the method to be used to get the flood water from the Wisconsin River up into the Mead Reservoir.

Pumping vs. Diversion

One early plan called for diverting water from the Wisconsin to the proposed reservoir by raising the power dam at Mosinee 6 ft., constructing a 6½-mi. canal from Mosinee to the existing Eau Pleine reservoir and making a cut 3,500 ft. long connecting the Eau Pleine and the proposed new reservoir. The canal would have diverted a maximum of 12,000 cfs. The diversion canals and a reservoir with a capacity of 595,000 acre-feet was estimated in 1939 to cost over $6,-000,000. This was considered excessive and the canal project was discarded.

The present plan of pumping water from the Wisconsin River into a proposed reservoir in the Little Eau Pleine valley was conceived by W. F. Thiele, chief engineer of the Consolidated Water Power & Paper Co. and will cost an estimated $2,750,000.

Under Thiele's plan, flow of the Wisconsin River in excess of 4,200 cfs. will be pumped into Mead reservoir up to the capacity of the pumps of 5,000 cfs. It will take 31 days at this rate to fill the three-quarters of the reservoir capacity that will not be supplied by flow of the Little Eau Pleine River. Pumping load will be approximately 10,000 kw. and it is estimated that it will require 7,500,-000 kw.-hr. annually. Since this pumping load coincides with surplus river flow on the Wisconsin and other rivers of the state, the electric rate assumed on pumping is based on dump hydro values. A conservative figure of 3.3 mills a kw.-hr. has been used which includes 0.3 mills for the substation cost until the latter has been amortized.

Storage Generation Uneconomical

Consideration was for a time given to use of the pumping units as turbo-generators when water was being released from the reservoir. It was estimated that the electric energy which could be generated would be about half of that which was required for pumping. Investigation disclosed, however, that royalties for this dual function, together with the high cost of the special concrete for siphon arrangements and the additional outlay of equipment, made the plan of generating power at the reservoir uneconomical and it was discarded.

Pumping will be done by four vertical-shaft units each consisting of a 164-rpm. synchronous motor, direct-connected to a 3,200-hp. propeller-type pump with a 110-in. diameter rotor. Pump blades will have adjustable pitch, controlled by a servomotor, so that they can be "feathered" for starting. All four pumps will operate against a head varying from 12 to 25 ft. They will discharge 2½ million gallons a minute at a head of 18 ft.

Table I.

Reservoirs of Wisconsin Valley Improvement Co.

NAME	RIVER	DRAINAGE AREA (SQ. MI.)	SURFACE AREA FULL (ACRES)	DRAWDOWN (FEET)	STORAGE (ACRE-FEET) WINTER	SUMMER
Lac Vieux des Sert	Wisconsin R.	28	4,780	3.17	13,650	13,650
Twin Lakes	Twin R.	26	3,480	2.0	2,950	5,800
Buckatahbon Lake	Buckatahbon Cr.	14	1,200	3.17	3,250	3,250
Long Lake	Deerskin R.	35	2,535	3.75	8,800	7,250
Little Deerskin Lake	Little Deerskin Cr.	5	320	2.0	505	505
Seven Mile Lake	Seven Mile Cr.	14	1,160	4.33	2,700	2,700
Lower Nine Mile Lake	Lower Nine Mile Cr.	25	730	4.67	2,130	2,130
Burnt Rollways Lake	Eagle R.	129	6,980	4.0	13,700	8,850
Division No. 1		237 (1)			51,685	44,135
Sugar Camp Lake	Sugar Camp Cr.	59	2,135	5.5	7,700	3,650
Little St. Germain Lake	Little St. Germain Cr.	19	1,005	3.33	3,250	3,250
Big St. Germain Lake	St. Germain R.	69	3,000	3.0	5,570	2,360
Pickerel Lake	St. Germain R.	78	700	10.0	5,730	1,330
Rainbow Reservoir	Wisconsin R.	740	5,500	19.0	46,300	46,300
Division No. 2		503 (1)			68,550	56,890
North Pelican Lake	North Br. Pelican R.	71	1,490	3.92	4,700	.....
South Pelican Lake	South Br. Pelican R.	22	3,515	2.0	7,000	.....
Division No. 3		93			11,700	.....
Minocqua Lake	Tomahawk R.	89	7,245	2.33	14,930	6,700
Squirrel Lake	Squirrel R.	17	1,955	2.17	3,500	3,500
Willow Reservoir	Tomahawk R.	327	7,700	18.5	77,000	77,000
Rice Reservoir	Tomahawk R.	548	4,385	13.0	41,000	41,000
Division No. 4		548 (1)			136,430	128,200
Spirit Reservoir	Spirit R.	174	2,500	17.0	17,800	17,800
Division No. 5 Subtotals, Upper Reservoirs		1,555 (1)			286,165	247,025
Eau Pleine Reservoir	Big Eau Pleine R.	377	8,250	31.5	104,300	104,300
Division No. 6 Totals, Present Reservoirs		1,932 (1)			390,465	351,325
George Mead Reservoir	Little Eau Pleine R.	3,000 (2)	31,685	25.0	430,400	430,400
Totals		4,900 (1)			820,865	781,725

Notes; (1) Duplications eliminated. (2) Drainage area of Little Eau Pleine River only is 251 sq. mi.; the drainage area of the Wisconsin River at Reservoir is about 4,900 sq. mi.; of which about 3,000 sq. mi. is unregulated by other reservoirs.

Pump motors will be 4,000-volt three-phase units with two star-connected windings in parallel and will have pole-face amortissuer windings for starting as induction motors. One winding will be open during starting to limit inrush current.

Automatic control equipment will provide the proper sequence and timing in starting the units. These controls will feather the blades of the pump and open one of the motor windings. When the motor is closed to synchronous speed it will apply the d.c. field and connect the second stator winding. A hydraulically operated taintor gate between each pump bay and the reservoir will be coordinated with the servomotor so that the gate will be opened as the pump blades are adjusted to start lifting water.

Reservoir into which these waters will be discharged will occupy the site of the abandoned Dancy Drainage District in the Little Eau Pleine valley 25 miles south of Wausau. The earth fill dam to create the reservoir will be 16,100 ft. long, 270 ft. wide at its base and will have a 12-ft. crest rising 6 ft. above the water surface. Maximum dam depth will be 43 ft.

Lake formed behind the dam will be about 20 miles long, 9 miles wide and 25 ft. deep. It will cover an area of 50 square miles, and maintain 18¾ billion cu. ft. of water.

Cost of the project is $2,750,000. Annual tolls to be assessed upon the water powers benefited are estimated at approximately $225,000.

Table II

Hydro Stations Benefited by Reservoirs

NAME	OWNERSHIP	HEAD (FEET)	DRAINAGE AREA (SQ. MI.)	CAPACITY ELEC. (KW.)	MECH. (HP.)	RESERVOIR DIVISIONS
Otter Rapids	Utility	12.6	533	700	.....	1
Rhinelander	Paper Co.	32.7	861	2,300	.....	1 & 2
Hat Rapids	Utility	20.2	1,143	1,760	.....	1, 2, 3
Nigger Island	Undeveloped	(43.0)	1,236	.....	.....	1, 2, 3
Kings Dam	Paper Co.	22.8	1,297	.....	3,300	1, 2, 3
Jersey (1)	Utility	14.8	557	512	.....	4
Tomahawk	Utility	14.5	2,028	2,600	.....	1 to 4
Grandmother Falls	Paper Co.	19.1	2,269	3,000	.....	1 to 5
Grandfather Falls	Utility	93.3	2,293	17,240	.....	1 to 5
Bill Cross Rapids	Undeveloped	(26.0)	2,320	.....	.....	1 to 5
Alexander	Utility	22.6	2,520	4,200	.....	1 to 5
Merrill	Utility	14.5	2,780	840	.....	1 to 5
Trappe Rapids	Undeveloped	(24.0)	2,900	.....	.....	1 to 5
Brokaw	Undeveloped (2)	(18.0)	3,016	.....	.....	1 to 5
Wausau	Utility	27.3	3,092	5,400	.....	1 to 5
Rothschild	Paper Co.	21.1	4,016	3,400	.....	1 to 5
Mosinee	Paper Co.	22.2	4,126	3,050	.....	1 to 5
Subtotals, Upper River		337.7 (111)	.....	45,002	3,300	
DuBay	Utility	25.4	4,900	7,500	.....	1 to 6
Jackson Mill	Utility	17.4	4,964	3,840	.....	1 to 6
Upper Stevens Point	Paper Co.	21.0	4,969	1,000	6,250	1 to 6
Lower Stevens Point	Paper Co.	8.0	5,134	.....	900	1 to 6
Biron	Utility	24.0	5,341	3,500	8,800	1 to 6
Wisconsin Rapids	Utility	31.3	5,391	4,500	10,100	1 to 6
Centralia	Paper Co.	15.5	5,401	3,600	.....	1 to 6
Port Edwards	Paper Co.	16.9	5,405	1,320	3,400	1 to 6
Nekoosa	Paper Co.	22.0	5,564	2,700	2,600	1 to 6
Petenwell	Undeveloped	(44)	5,800	.....	.....	1 to 6
Germantown	Undeveloped	(26)	7,000	.....	.....	1 to 6
Wisconsin Dells	Utility	23.9	7,746	6,200	.....	1 to 6
Prairie du Sac	Utility	37.8	8,944	22,520	.....	1 to 6
Honey Creek	Undeveloped	(12.0)	9,080	.....	.....	1 to 6
Muscoda	Undeveloped	(20.0)	10,300	.....	.....	
Subtotals, Lower River		243.2 (102)	.....	56,680	32,050	
Totals		480.9 (213)	.....	101,682	35,350	

Notes; (1) Jersey Hydro Station is on the Tomahawk River; all the rest are on the Wisconsin. (2) The dam at Brokaw washed out in 1941.

DRYING OUT a Spare Furnace Transformer

P. A. EMMONS, JR.*, *Test Engineer, Carolina Aluminum Co.*

A 3,480-KVA., single phase, 13,200-201-volt 60-cycle furnace transformer for indoor service was removed from service in 1939 and stored outside with a wooden shed over the cover. A test made shortly after the transformer was removed from service showed 1.1 percent (corrected to 20 deg. C.) power factor at 10 kv. for the high winding to the grounded low winding. In November, 1944, the power factor had increased to 5.4 percent and it was decided to dry out the winding.

The winding was removed from the tank for cleaning; the cooling coils were found heavily sludged. After cleaning the winding was retanked and the tank filled to the normal operating level with the original oil which had been filtered and treated with activated alumina to reduce the acidity to 0.06 from 0.58 mg. KOH. The transformer tank (excluding the cover) was covered with ½-in. felt. The manhole cover was blocked up 2 in. to provide tank ventilation.

Short circuit drying was started July 16 and the top oil temperature was raised to 80 deg. C. Hourly readings of load current and top oil temperature were made. Three-minute Megger insulation tester readings of high-low, high-low grounded, and low-high grounded resistances were made daily (Fig. 1). Reading of capacitances and dissipation factors were made at intervals during the heat run and subsequent cooling (Fig. 2). Insulation resistances were measured as the winding cooled to ambient (Fig. 3).

Dr. A. E. Flowers of the DeLaval Separator Co. in a paper, "Some Effects of Moisture in Insulating Oils," presented before the Sixth Annual Conference of Doble Clients in 1939 stated "that *dissolved* moisture has no effect at all on the electric breakdown test as measured by the standard gap of 0.100 in. between a pair of 1-in. diameter discs."

On August 18, the transformer oil was circulated through the reactivator to lower the acidity. Immediately after treating was started the insulation resistance dropped sharply. Accepting Dr. Flowers' statements of moisture effects on oil the following explanation of the resistance drop may be made. As the cooler oil from the bottom of the transformer circulated through the treater its temperature was reduced further so that on being pumped back into the top of the transformer it reduced the temperature of the top oil. This top oil contained a relatively large amount of dissolved moisture which was condensed to suspended water by the cooling action of the treated oil. The solid water was carried down and came in contact with the fiber insulation and the insulation resistance was lowered. This explanation seems to be borne out by the change in capacitance (Fig. 2). After treating, which reduced the acidity to 0.09 mg. KOH, was finished and filtering started the insulation resistances again began to increase. The curves indicate a normal increase of resistance with decreasing temperature and do not break downward at 40 deg. C. which would be expected if moisture were present in any appreciable quantity. The transformer was considered ready for service.

The transformer remained out of service stored inside. In February, 1946, the power factor at 10 kv. was 1.98 percent corrected to 20 deg. C.

* From paper at 1946 Doble Client Conference.

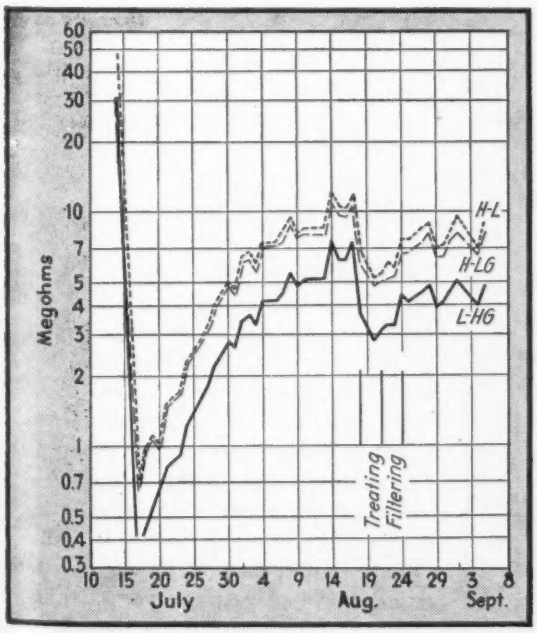


FIG. 1—Insulation resistance improves during drying but note drop during oil-treating operation

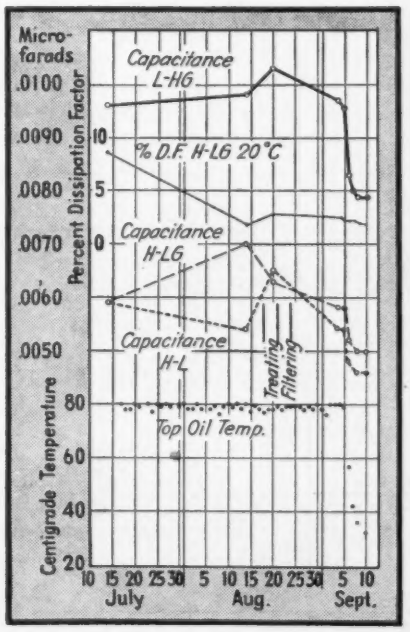


FIG. 2—Dissipation factor, capacitance and temperature during drying operation

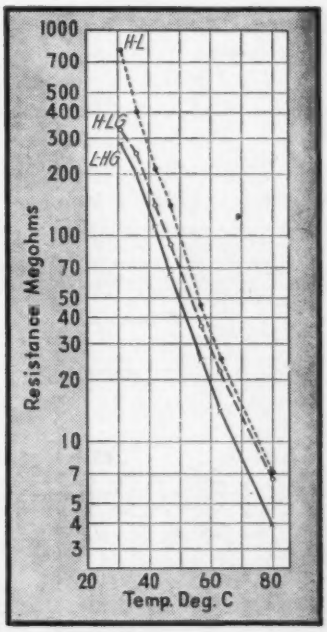


FIG. 3—Insulation resistance increases during the cooling period subsequent to drying operation

BULK TRANSMISSION by A.C.

Favored by Germany

Critical study by engineers early in war showed less investment and lower transmission cost for 400-kv., 3-phase than for 650-kv. d.c. overhead or 800-kv. d.c. cable systems*

IN 1942 German engineers, after studying the technicalities and economics of transmitting 2,000,000 kilowatts a distance of 600 kilometers (375 miles), concluded that a 3-phase, 400-kv., 50-cycle system would have been the answer if the lines had to be built at once. Could the construction be deferred until rectifiers and inverters would be certain in competency and lowered in cost, direct current transmission by 400-kv. cable (an 800-kv. system with midpoint grounded) might have become a feasible competitor. At least such d.c. cable system would have been practically equal in initial outlay and in cost per kilowatt-hour delivered to a 650-kv. d.c. overhead system (midpoint also grounded). Both would, however, cost more than a.c. in terms of the delivered energy, the cable a fifth more and the d.c. overhead line a third more.

Hitler's department for economic expansion had issued the orders to make the study but the report filed gave no clue to the point of departure of the high-tension bulk-transmission system nor where the delivery was to be made. Nevertheless the data in the voluminous report do record certain significant contributions to the pending argument whether, if such bulk transmission can be justified in this country, the advocates of a.c. or of d.c. have the better case.

Six modes of transmission were stipulated in the order, as follows:

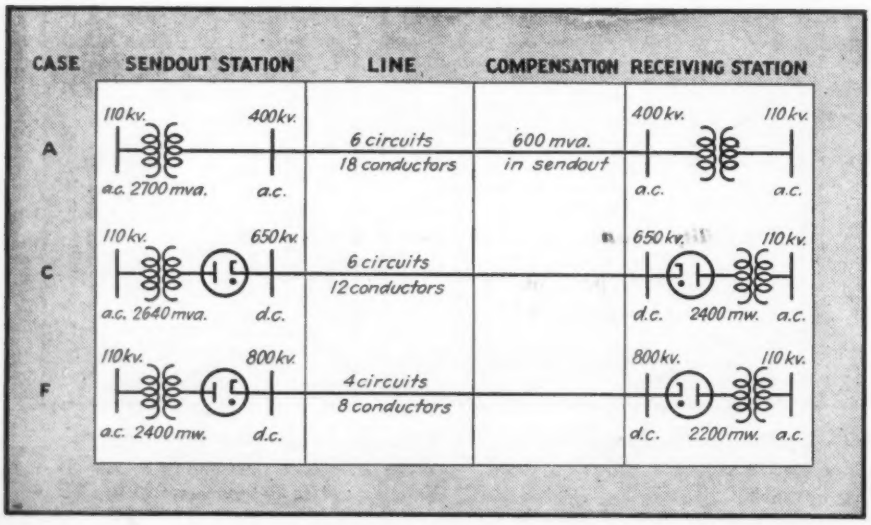
A. Three-phase
   1. Overhead line
      a. 50 cps.
      b. Half-wave frequency (239 cps.)
   2. Cable
      a. 50 cps.
      b. $16\frac{2}{3}$ cps.

B. Direct Current
   1. Overhead line
   2. Cable

It developed that the efficiencies of a 239-cycle overhead line and 50- and $16\frac{2}{3}$-cycle cable systems were too disadvantageously low (0.778, 0.73 and 0.68 respectively) to warrant much further analysis. Thus the report focuses on (1) 50-cycle 400-kv., (2) 650-kv. d.c. overhead line and (3) 800-kv. d.c. cable systems. These were thereupon studied in the light of the prescriptions (1) that energy was to be transmitted in one direction from an ample source center to a significant consuming center and (2) that annual hours use were to be such as to constitute a high load factor. Actually the studies were based on 5,000, 6,500 and 8,000-hours use.

Little consideration was given to determining the most economical voltage to use because it was taken for granted that the highest practicable voltage would have to be adopted to handle 2,000 megawatts over 600 kilometers. Study of corona data indi-

FIG. 1—Of six systems initially contemplated only those illustrated here proved economically or technically feasible



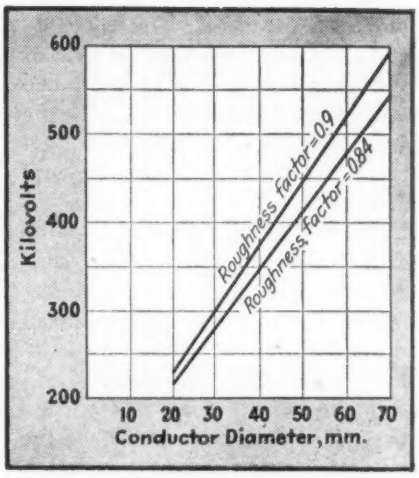


FIG. 2—Conductor diameter fixed at 50 mm. for 400-kv. a.c. and equivalent d.c. aerial voltages

* Adapted from translation by Detroit Edison engineers, under direction of Walker L. Gisler, of original reports obtained by Otto Jensen (I-T-E Circuit Breaker Co.) during his service as a member of TIIC.

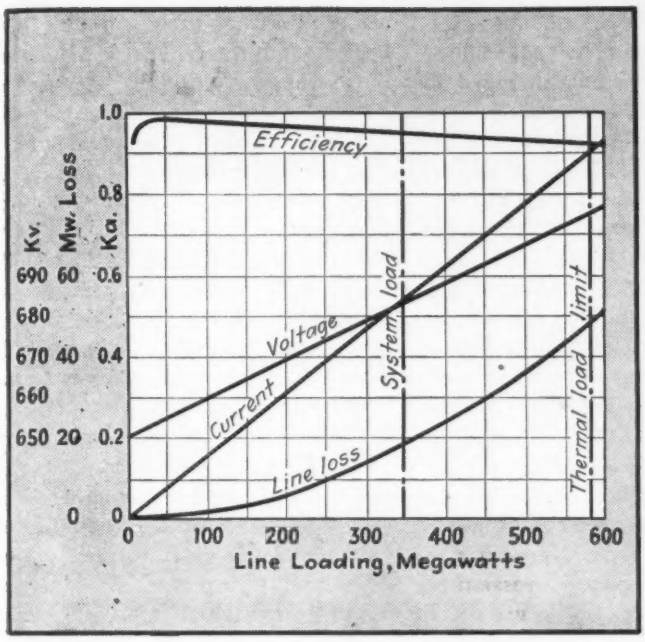


FIG. 3—Calculated performance for transmission of 2,000 megawatts over 600 kilometers by six 650-kv. d.c. overhead circuits on towers

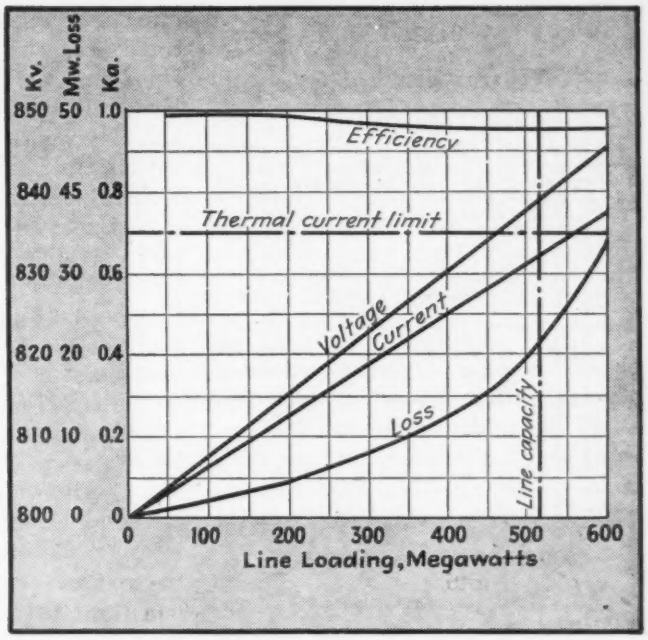


FIG. 4—Calculated performance for transmission of 2,000 megawatts over 600 kilometers by four 800-kv. d.c. cable circuits

cated that 400-kv. 3-phase would be permissible if the conductor were sufficiently in excess of the critical diameter of 40 mm., say 50 mm. The d.c. voltage could be the corresponding crest value to ground, namely 325 kv., for the overhead line, affording the basis for a 650-kv. "3-wire" system. Actually the neutral wire would be the earth because it would be called on to function only under conductor fault conditions.

D. C. Voltage Raised

Voltage for the d.c. cable was upped to 400 kv. to ground (800-kv., "3-wire") for the analysis, despite the fact that some of the cable manufacturers who were consulted demurred at the jump. It was admitted that harmonics from the rectifiers and inverters would have to be sharply limited if such advantage was to be taken of the tacit absence of alternating stress on the dielectric.

No doubt was expressed about the ability of transformers and switching to meet the high voltages but it was candidly admitted that there would have to be more progress with rectifiers and inverters before they could confidently be the core of systems for such high d.c. voltages. It was asserted quite definitely that 3-phase a.c. voltages above the 220-kv. (used in Paris) were not justifiable for cable application.

Six banks of three single-phase 150-mva. transformers would be provided for the step-up to 400 kv. Various supply plants would feed in over twenty-four 110-kv. lines and a similar arrangement would distribute from the receiving, step-down station. Each transformer would have 10 percent buck and boost regulation and be provided with coils to compensate for ground faults.

Four transmission circuits would not give sufficient margin within stability limits and no reserve in case of a line being interrupted. Five circuits would cost nearly as much as six so the decision was for six 400-kv. lines.

Conductor characteristics indicated by the corona studies were such as to require hollow steel reinforcement of aluminum strands totalling 630 square millimeters; outside diameter, 500 mm., resistance 0.05 ohms per kilometer at 45 C. conductor temperature. Unit inductance was computed at 1.305×10^{-3} henries per kilometer and capacitance at 9.36×10^{-9} farads. Leakage was assumed to be 0.5 kw. per km.

Stability Limits

Thermal power limit per line was determined to be 623 megawatts (900 amp. per conductor). Reactive required for 400-kv. maintenance at the receiving end were 100 mvar. and charging (at 400-kv.), 217 mvar.

Instability limit (called tipping limit by the German engineers) was computed at 685 megawatts but, to ride safely through faults, the working limit was set at two-thirds this figure, 457 mw. A practically identical figure, 467 mw., was established by consideration of transformer and machine reactances and transmission at unit power factor with voltage spread from 440 kv. to 360 kv. at the receiving end.

Transmission Losses and Costs

Power lost on all six lines when handling 373 mw. per sendout bank (335 received) was found to be 166.34 mw. This was attributed as follows: 38.64 mw. due to voltage and 127.7 mw. due to current.

The investment required for the six 400-kv. 3-phase lines including the transformer stations at both ends turned out to be an estimated 176 Reichsmarks per kilowatt as indicated by the following compilation (there was a time when the mark was worth 23.8 cents);

Component	Unit Cost	Reichsmarks
Step-up station	20.50/kva.	55,350,000
Step-down station	20.50/kva.	55,350,000
Tertiary reactors	6.50/kva.	3,900,000
Ground Fault Compensators	18.50/amp.	7,400,000
Total Transformer Stations	.....	122,000,000
Line	127,500/km.	229,500,000
Total	176/kw.	351,500,000

Investment charges and operating

Table I

Voltage Conditions for 600-Km. Transmission of 2,000 Mw.

Case Type	A Overhead	C Overhead	F Cable
Voltage, Kv.	400 (a.c.)	650 (d.c.)	800 (d.c.)
Sendout E, Kv.	395	682	839
Received E, Kv.	400	650	800
Regulation, %	1.27	4.7	4.65
Sendout P.F.	0.968	....	....
Received P.F.	1.00	....	....
Total Losses, Mw.	166.34	207	204.8
Efficiency	0.923	0.907	0.909

losses combined to produce the following estimated costs per kilowatt-hour depending on the hours of annual use: 5,000 hours, 0.42 pfennig; 6,500 hours, 0.323; 8,000 hours, 0.263. A pfennig is 1/100 of a mark.

650-Kv. D. C. Overhead Line

Admittedly the rectifiers and inverters for conversion to d.c. voltages higher than 200 kv. to ground were not at hand but their prospective development was viewed hopefully by Calliess and Krohne who reported the studies.

Nor were corona and insulation considered stumbling blocks, provided the continuous voltage be not chosen higher than the crest of the value corresponding to a 400-kv., 3-phase system viewed in relation to ground potentials. This meant that each conductor in the air could have $\sqrt{2}$ x $400/\sqrt{3}$ or 325 kv. impressed on it without encountering prohibitive corona losses even under fault conditions which might entail sharp voltage rise. Actually this afforded a chance to use a 650-kv. system by omitting the "middle wire" and grounding the midpoint at both ends. Earth resistance could be made low enough to carry approximately half-load on a circuit while the faulted side was being cleared or even repaired.

Six circuits would be installed on three tower lines using a hollow-steel-cored conductor with 630 sq. mm. of aluminum, the resistance being 0.05 ohms per km. and leakage 0.5 kw. per km. Thermal power limit (the same 900 amp. per conductor as for 400-kv. 3-phase) was 585 megawatts per circuit. Under conditions of 345 megawatts per line the losses were computed to be only 17.2 megawatts per line and the voltage drop 32 kv. Including the estimated conversion losses the total losses (six circuits) would be 207 mw.

Costs for the conversion stations were substantially higher than for the 3-phase transformation stations as might be expected when adding the rectifiers and inverters. However, the line cost was only some 70 percent as much, largely based on the use of 12 conductors rather than 18. All of this is tabulated below:

Component	Unit Cost	Reichsmarks
Step-up and Rectifier	50/kw.	132,000,000
Step-down and Inverter	70/kw.	168,000,000
Total Terminal Costs	.....	300,000,000
Line (6 circuits)	.....	153,000,000
Total	226.5/kw.	453,000,000

In this instance the costs of transmitting the energy, including investment charges, were stated to be: for 5,000 hours, 0.566 pfennig per kw.-hr.; 6,500 hours, 0.435; 8,000 hours, 0.354.

D. C. Cable at 800 Kv.

Despite the unwillingness of some of the cable manufacturers to "go along" the engineers confidently believed that cables could be designed and worked at 400/440 kv. to ground. Their confidence was predicated on the belief that continuous unidirectional electrical stress on cable insulation comfortably below the breakdown value avoids the deterioration encountered with alternating potential gradients. This, however, would dictate the minimization of harmonics from rectifiers and inverters to, say, 2 percent at 300 cps.

Under these assumptions four 400-kv. cable lines were contemplated, the four being taken equivalent in reliability to the six overhead d.c. circuits. The eight cables would be laid in two trenches. Each conductor would have a diameter of 28.6 mm; paper thickness, 20.0 mm.; lead, 2.9.; armor, 6.0 mm.; all giving an outside diameter of 86.4 mm. Permissible continuous current would be 700 amp. and resistance 0.0506 ohms/km. Dielectric losses (essentially "leakage") would be 0.3 kw. per km. Maximum transmissible power would be 560 mw. per circuit and the usable value (with 3 percent losses) 515 mw. Voltage drop under 515 mw. loading would be 39 kv.

Outlay was estimated to be somewhat less than for the overhead d.c. line but still in excess of the investment required for the 3-phase 400-kv. system as indicated by these figures:

Component	Unit Cost	Reichsmarks
Step-up and Rectifiers	....	126,000,000
Inverter and Step-down	....	161,700,000
Cables	....	130,000,000
Total	208.85/kw.	417,700,000

Likewise the cost of transmitting the energy was found to be less than for the 650-kv. overhead d.c. line but more than for the 400-kv. 3-phase 50-cycle system, thus: at 5,000 hours annual use, 0.512 pfennig per kw.-hr.; 6,500 hours, 0.395; 8,000 hours, 0.321.

Table II

Transmission Costs in Pfennigs per Kilowatt-Hour

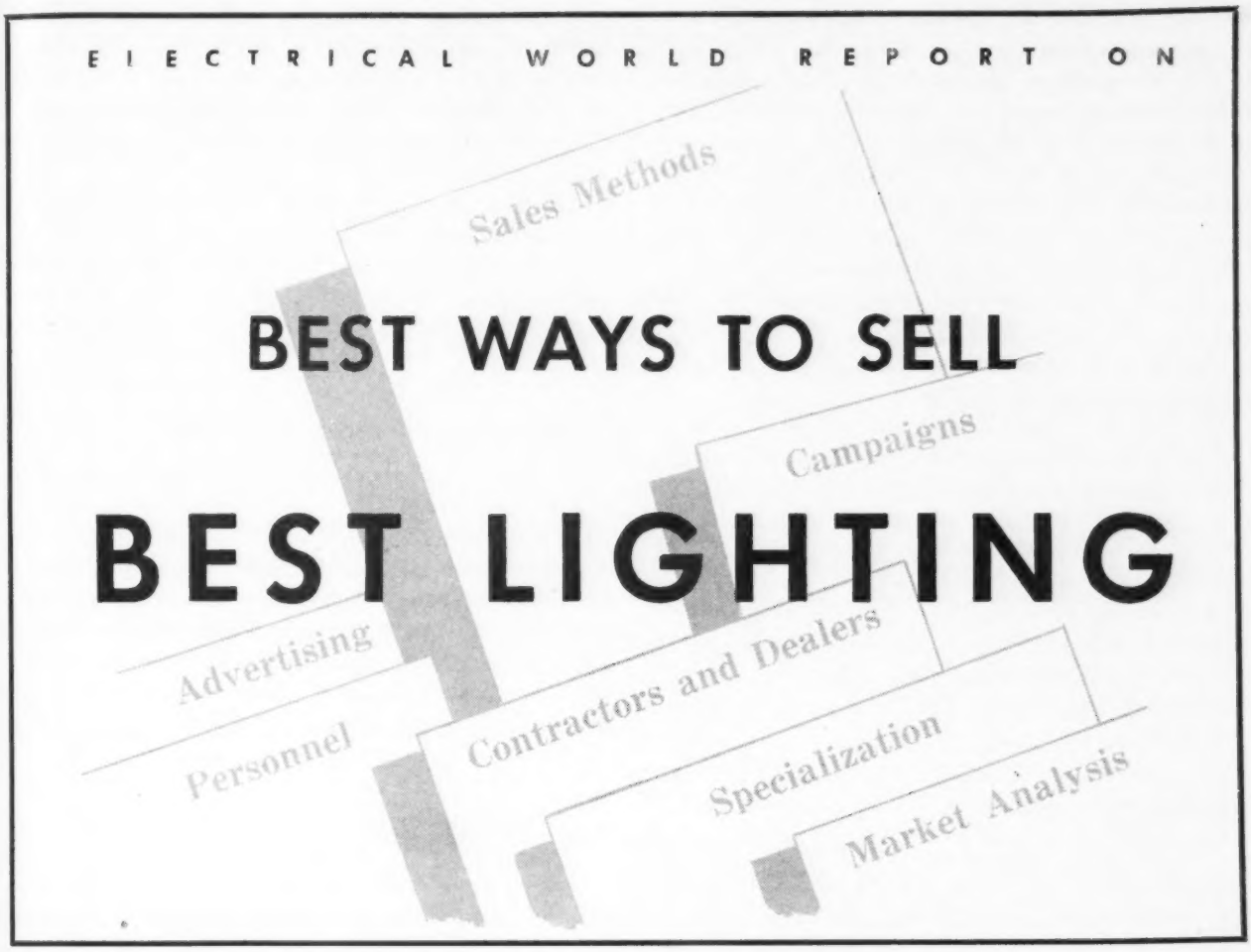
Case Type	A Overhead	C Overhead	F Cable
Voltage, Kv	400 (a.c)	650 (d.c.)	800 (d.c.)
At 5,000 hr./yr.			
Capital	0.329	0.451	0.400
Losses	0.091	0.115	0.112
Total	0.420	0.566	0.512
At 6,500 hr./yr.			
Capital	0.253	0.347	0.308
Losses	0.07	0.088	0.087
Total	0.323	0.435	0.395
At 8,000 hr./yr.			
Capital	0.206	0.282	0.250
Losses	0.057	0.072	0.071
Total	0.263	0.354	0.321

Table III

Metric Tons of Material Required

Case Type	A Overhead	C Overhead	F Cable
Voltage, Kv	400 (a.c.)	650 (d.c.)	800 (d.c.)
Iron			
For Stations	20,340	42,600	41,000
For line	153,000	102,000	16,900
Total	173,340	144,600	57,900
Aluminum			
For Stations	540	680	650
For line	22,500	15,000	9,000
Total	23,040	15,680	9,650
Copper and Brass			
For Stations	2,480	6,270	6,000
For line	.....	.....	790
Total	2,480	6,270	6,790
Lead			
For line	.....	.....	39,600

ELECTRICAL WORLD REPORT ON



FRANK R. INNES, *Associate Editor*

"While tremendous (post-war) activity in the commercial lighting market is assured, there is no certainty of increased revenue to the utility. There are possibilities of appreciable losses in revenue. The utilities that promote commercial lighting aggressively in the transition period immediately following the war will be most effective in obtaining good fluorescent lighting installations throughout their territories. They will then be in a position to build on a more favorable basis."

The foregoing paragraph is quoted from "Post-War Lighting Markets," Section VI, Report of Commercial Planning Committee, Edison Electric Institute, published August, 1945. It is now over a year since the ending of hostilities. What heed are the electric utilities giving to the admonition contained in the quoted paragraph?

Convincing Testimony

One singe piece of evidence shows that they are taking it very seriously indeed. This is the number of replies received in response to ELECTRICAL WORLD's request for information on which the study reported in the 15 following pages is based. In the long experience of the writer in conducting editorial surveys of many kinds, no response from the field was ever so numerous and comprehensive as in the present case. Usually a considerable amount of prodding—follow-up letters, sometimes telegrams and personal calls—is required to elicit a sufficient number of replies to justify valid general conclusions. In the present instance, the amount of such prodding was extremely small. It was not necessary; the replies came in without it, 103 of them from 204 letters sent out, over a 50 percent response. Even with repeated urging, a response like this is extraordinary.

Getting Set for the Job

On this evidence alone it is to be concluded that the electric utilities are fully aware of the prime importance of lighting load development in the conditions of this post-war time and are effectively organizing to direct it in their customers' and their own best interests.

It would be pleasant reading to report as a conclusion of this survey that the utilities are now doing a completely fine industry-wide job of selling modern lighting. But that would not be true. However, it can

be said that they are getting well set for the job. Some are much further along than others. The result is that the practices, methods and policies disclosed in the following pages are a mixture of things being done and of things planned to be done. No attempt was made to separate the two in writing up the survey, because it is a presentation of ways to sell modern lighting, not a report of progress in lighting sales. Thus the practices disclosed here are in use, are in process of being put into use, or are planned for early use.

Held Up by Shortages

There are several reasons why the industry is not further along on the job. One is a lack of competent man-power. This lack is apparent not only in the field of lighting sales, but also in the installation of lighting. Contractors do not have all the men they need to pull in wires and hang fixtures. When promising applicants for the sales job are found they must be trained and that takes time. There is a general shortage of fixtures and other necessary equipment and materials.

No Time to Prepare

These conditions are made more difficult by the situation that brings them into being. The market is so good that the necessary immediate attention to it hinders adequate preparation for handling it. One reply puts it:

"The demand for new lighting has somewhat changed our method of selling. We often find the interview forced on us and our men are faced with the problem of assisting the customer to locate equipment as well as helping him get the most for his lighting dollar. These interviews naturally are hurried because we receive more calls than we can handle with present manpower."

Men and Materials Needed

The effect of shortage of fixtures and materials is stated in another reply:

"It is discouraging to our men to sell customers on good lighting installations and then be unable to tell them where to get the necessary equipment. Thus our efforts have been greatly retarded and our promotion not as fully developed as it should be, because of the small amount of equipment available."

Typical comments regarding manpower and equipment are:

"We have found it very difficult to secure the type of help required to carry on adequately a promotion of this kind."

"When suitable men are available we expect to increase the present coverage by 50 percent."

"Our efforts at present have to do with recruiting personnel, as we were pretty well stripped of manpower by the Armed Forces and we find it is necessary to do a lot of training before we are ready to go all out. Also the difficulty of obtaining lighting equipment and wiring materials is retarding expansion of dealer activities."

"We have so far laid out no definite activities, partly because of the scarcity of commercial fixtures, ballasts and other equipment and because it is extremely difficult to get wiring changes made by contractors who are short of skilled workmen and of wiring materials."

Temporary Hindrances, Not Stops

The difficulties indicated by the preceding quotations are important at present, but they are not permanent. They are holding up the parade but they can't prevent it. By the time that manufacturers are able to supply the necessary goods in sufficient volume, the utilities will be ready with adequate and competent personnel to sell the modern lighting installations to absorb those goods. That is plain from the replies. Also it is apparent that most utilities look for the lighting sales job to get going under full steam next year.

Some Exceptions

Out of all the replies, there was only one that said definitely no lighting sales or any other new business activities would be pushed, probably not for two years, because of insufficient generating capacity to supply the resulting load. Two others said no plans had yet been made because lighting equipment is not easily available. These three are the only exceptions in the general chorus of reported activities and plans.

Epitome of the Study

In final introduction to the detail of the following pages, it seems worthwhile to quote from two replies paragraphs that sum up the whole situation. In them is epitomized all that follows.

"We are convinced, from previous experience, that an active and aggressive plan of lighting sales promotion can be operated at a cost of from 40 to 60 cents per dollar of increased annual revenue, will improve customer relations materially, and win acceptance of other uses of electricity at an ever-increasing rate. Fluorescent lighting has introduced some new problems, but it has not changed any of the basic principles of sales promotion work."

"We believe that a staff of good lighting men, well trained in their specialty, can be a most valuable asset to any utility, for, after all, lighting is the most desirable type of load we can get. It costs the least to sell and the least to serve and when all is said and done, it is the lighting revenue that pays the dividends on the common stock."

SALES METHODS

Under this head are considered the ways in which the salesman shows the customer what is an adequate and effective modern lighting installation in the particular premises and how such an installation is to be obtained. This service is never an expense to the customer and its provision at no charge is good business on the part of the utility, particularly as regards commercial customers, the revenue from whom mostly derives from lighting load.

The Waiting Market in Commercial Lighting

As is pointed out in one reply, during the war years it was almost entirely in the industrial field that new lighting installations were made. Before then there had not been time for the new thing, fluorescent lighting, to do much more than get started among commercial customers. Because these customers were generally unable to obtain priorities for lighting equipment and wiring materials while the war was on, they now constitute a large waiting market for advantages and benefits of modern lighting.

Danger of Loss of Revenue and of Poor Performance

Unless this market is properly guided in its buying, it is practically certain that a significant decrease in utility revenue will occur. Hence the strong concern of utilities in the proper and adequate application of fluorescent lighting. Additional to their primary motive of guarding and, if possible, increasing revenue, there is another powerful reason for the utilities to work hard for right and sufficient fluorescent application. This is the fact that fluorescent lighting can be, and often has been, a grievous disappointment to the user if it was not installed with attention to its deficiencies as well as to its advantages.

A Case in Point

The record of one power company brings out the danger to revenue. From 1938 through 1941, 696 replacement fluorescent installations were made, resulting in a net reduction of 17.5 percent in the total lighting load of the customers included. However, in 1941 aggressive lighting sales promotion was getting underway and replacements of incandescent by fluorescent lighting in the second half of the year averaged 100.9 percent of previous loads. Not all electric utilities have determined so definitely as this the result of letting fluorescent lighting find its own way into their customers' establishments, but all are acutely cognizant of its threat to revenue.

Lighting Layouts at No Charge

Principal reliance in selling modern lighting to commercial and industrial customers is on illuminating engineering service. This is in the form of engineered layouts showing locations and mounting heights of fixtures and sizes and kinds of light sources. Over three-quarters of the replying utilities said specifically that they offered this no-charge service to their customers and it can be taken for granted that the practice is general among utilities replying less definitely because not any said it was not done or would not be.

Contractors Not Usually Capable of Making Layouts

Supplementing the previously stated reasons for the making of lighting layouts by utilities is the fact that contractors and dealers do not usually have men capable of that work. This is particularly the case in the smaller cities and towns. Also, contractors generally are now so busy with other work that they do not have time to be illumination experts. The lack of contractor and dealer personnel qualified to do lighting design is being met by training programs which will be discussed later.

Two Kinds of Layouts

Layouts are of two general kinds, one quite simple and the other more elaborate. The simpler one is made on the spot for small installations by the salesman when he calls on the customer. It may be a pencil drawing on plain paper made while the customer watches. Or it may be on a standard form supplied by a manufacturer or designed locally. For larger installations a finished drawing is usually made in the utility office. Blueprint or photostat of this is frequently bound in a cover with other pertinent material and then presented to the customer.

Keep Layouts Simple as Possible

Two reasons dictate that layouts be kept as simple as possible. One is that the customer is more likely to be confused than enlightened by a complicated drawing. The other is that the simpler it is the more easily and quickly it can be made, thus saving draftsman's time or freeing the salesman to make other calls. As one reply put it, "It has long been our firm belief that there is no substitute for shoe leather in selling and that the old tomcat story still holds good—that you have to make the calls if you want to show results."

For the usual area lighting installation layouts are made only in plan. For these there is little need for

the sectional views or elevations that may be desirable or necessary to make clear the design for show window illumination or for "accent" lighting. Also, a plan drawing is simplest and easiest to make.

Check and Approval by Registered Engineer

When a lighting installation is so large that its design, including electricity provisions, is a real engineering job, then in states that have such laws it becomes the responsibility of a registered engineer. One reply mentions the designation of a staff engineer whose duty is to check and approve layouts in accordance with the registration law.

Prettying Up the Proposal

Sketches, color renderings, and other ways of visualizing the proposed installation for the customer are not commonly used. However, they are used by more than just a few utilities and several indicated in their replies that they would be used or were under consideration. It seems evident that in the present situation such helps towards favorable customer decision are not considered necessary, but that they are sort of being held in reserve until the coming time when customers will be more reluctant than now. The attitude appears well expressed in one reply to the effect that the utility plans to expand the use of sketches, to put emphasis on colored layouts as against plain drawings because color appeals to the prospect and gives him a better idea of the proposed installation. Blue prints, it is remarked, are rather drab in their sales appeal.

Fixture Recommendations

Generally it is the practice to be specific in making recommendations as to types and kinds of fixtures, but to leave room for choice as between products of different manufacturers. This is done by designating by catalogue numbers or otherwise the fixtures of two or more makers or, when only one is given, by adding the words "or equal."

Wiring Specifications

Practices as to wiring specifications are widely various. Some utilities do not include them with lighting layouts at all. Some do so only if the customer requests it. With others complete specifications are a standard part of lighting proposals. When included, wiring specifications range from mere suggestions as to switching, through indicated circuit arrangements, to exhaustive statements of feeder and circuit conductor sizes, and complete bills of material. These variations are dependent frequently on the size of the proposed installation, as is indicated by the following quotation from one reply:

"On larger jobs complete specifications are furnished to customers or to architects covering the wiring material to be used, sizes of conductors and of conduits, panel boards, service entrance equipment, fixtures, and miscellaneous items. We believe that the installation of adequate wiring, especially as to the service entrance, is of vital importance."

Reasons For and Against Wiring Specifications

If a contractor is handed a lighting plan that merely shows the locations of units and the sizes of light sources, he is quite likely in his desire to be low bidder to skimp in the provision of circuits and of switching and to use the smallest possible wire size, figuring the job to the minimum allowed by the National Electrical Code. From such practice as this results the kind of wiring that caused the Adequate Wiring Bureau to be organized and that more than justifies the expense of carrying on with it.

If, however, the contractor is given a layout that includes a wiring specification sufficiently explicit and detailed to assure him that this competitors will not be able to whittle the job down, then the customer should get an installation which will be amply adequate for its purpose.

Check and Protection

Another reason for wiring specifications is that the customer thus knows what he is to get in the job and can check the work of the contractor and has protection against being misled into accepting less than an adequate installation.

So runs the reasoning of those utilities that provide wiring specifications with lighting layouts. On the other hand are those that think wiring specifications are not necessary. They say that their lighting salesmen and engineers watch the job through from beginning to completion and thus know that the wiring is all that it should be. Also, in some instances the lighting salesman makes arrangements with the contractor and quotes the complete cost of the installation, wiring included, and the customer has nothing to do except pay the bills.

Benefit to Customer and Utility

In these ways it is made easy for the customer to obtain a modern lighting installation in his place of business and to realize the benefits therefrom. A good lighting job, utilizing whatever may be required from the resources of modern illumination techniques and designed for its purpose in the particular case, is thus assured to the customers. At the same time the utility is protected against the certain loss of revenue that would result if it made no effort to prevent the installation of fluorescent lighting on the simple basis of its high light production efficiency.

ADVERTISING AND PROMOTION

Generally speaking, utilities are vigorously pushing modern lighting into the public consciousness by every form of conventional advertising and by various other means of promotion and publicity. But there are some who are holding back entirely or in certain respects because the present volume of business is so large as to absorb available manpower and supply of equipment. In some instances little or no advertising now is a recession from plans previously made for more extensive promotion.

Direct Mail

Of all forms of advertising direct mail is the most widely and continuously used, particularly for commercial and industrial lighting. Material used is largely pieces supplied by manufacturers. Good results are attributed to syndicated promotional publications, bought by the utilities in block subscription for customers or in bulk for local mailing. Regular customer publications put out by the utilities themselves and featuring local installations are important in the direct mail field.

Mailing pieces locally prepared are frequently in the form of letters, signed by a utility representative, setting forth the advantages and values of modern lighting and offering the utility's services at no cost in obtaining them. Such letters are usually arranged in series for consecutive mailings and often they include photograph prints of local lighting installations in the same line of business as that of the prospect addressed.

Tabloid Style

One reply says that the utility is now preparing a mailing piece in tabloid newspaper style for distribution to residential customers to inform them of what is new and what is coming in home lighting.

Frequencies of mailings were not stated in many of the replies and it is to be assumed that they are determined by judgment in the particular circumstances. Some spoke of sending out their company publications at regular intervals and, of course, purchased publications have fixed mailing dates. One reply was more specific, mentioned six to eight direct mailings to commercial customers per year and three per year to industrial users of utility service.

Newspaper and Radio Advertising

Because of its greatly preponderant circulation outside of the specific fields, newspaper advertising is not regarded as a worthwhile expense in selling commercial and industrial lighting. The same is true of radio advertising, too much scatter-gun effect.

These two media do have great value in reaching the home lighting market. At present, however, this market is not so active as it will be later when fluorescent lighting has penetrated farther into it and fixtures and other lighting devices for using the new light source in homes become more easily available. Not to speak only of fluorescent lighting means for the home, portable lamps and fixtures using incandescent bulbs are still in very short supply. For these and other equally cogent reasons, newspaper and radio advertising is now less concerned with direct selling than with education on the need for modern lighting.

Bill Stuffers

Many utilities send out postcard bills to most of their customers and thus cannot enclose advertising pieces with them. But those who send bills in envelopes make large use of advertising enclosures. Here again, however, are the same deficiencies as in newspaper advertising; it is not of much use to send a promotional message on industrial or commercial lighting to residential customers.

Other Ways of Promotion

Apart from the accepted ways of advertising, lighting promotion is carried on in many other forms. Informative and educational programs consisting of talks, demonstrations and film showings and of sufficient entertainment value to hold a general audience are presented before civic clubs, women's organizations, church and school groups and neighborhood gatherings. These presentations have large resources of material to draw upon, films, demonstration equipment and scripts for whole shows available from manufacturers and trade organizations. Along this line, not a few companies, possessing the requisite local talent, prefer to, and do, "roll their own," making more or less use of material from outside.

Promotion Among Employees

Additional to the putting on of lighting shows and presentations by employees who have capability for such work, other utility personnel can be effective in promoting modern lighting, as is pointed out in one reply. "A great deal of our promotion this year has been directed to our own employees, so that cashiers, local managers, service men, and others in daily contact with our customers will be light and lighting conscious and will help by reporting prospects and by talking modern lighting."

An interesting promotional activity is contemplated by one utility. Its reply says:

"In the planning stage is an essay contest on commercial lighting for which all commercial customers will be eligible. Educational literature including entry blanks will be distributed and customers invited to write and enter essays on the values and advantages of modern lighting in business places. First prize in the competition, a modern store light installation."

Photographs of New Installations

In all phases of lighting promotion, including direct selling contacts as well as publication and direct mail advertising, large use of photographs of local installations is reported in the replies received. Because of this general interest, it should be useful to quote here the detailed plan of one company for procurement and use of such photographs.

"The commercial and industrial sales manager will make arrangements with a commercial photographer to take pictures of lighting installations all over the company territory. While making his rounds he can pick up 'before' pictures of store lighting where a job has been sold but is not yet installed. On his next trip around he will make a picture of the new installation. In this way an accumulation of 'before and after' pictures will be made.

"Copies of the lighting and wiring blueprints of the installation will be fastened in the salesman's book next to the photographs. Copies of any letters from customers expressing their appreciation of good lighting in their places of business will also be included.

"When sufficient pictures have been taken, each division can rearrange its particular book, taking out material on installations in other territories, replacing it with pictures and layouts of installations in the division. Thus each salesman will soon be able to show his customers pictures of stores in their own area and thus can capitalize on the interest of his customers in what their neighbors are doing to improve their business places by installing modern lighting."

SALES AIDS

To show what it is and how it functions and to prove its value by trial are three effective aids to selling anything. Indications from the replies are that these three ways fall in the order of demonstrations, first, displays, second, and trial installations, third, in application to the selling of modern lighting.

The reasons that demonstrations are used more widely than the other two aids are plainly apparent. One is that at the present time the market is so receptive that it is not necessary to call upon the other, and usually more expensive, aids very often. Another reason is that displays and trial installations require fixtures and equipment which are needed right now to meet the requirements of customers.

One Kind of Demonstration

There are so many factors involved in the consideration of modern lighting that to speak of demonstrations of it in any exclusive way is quite impossible. The term has so many different meanings. Here, for instance, is one:

"Our company is promoting and selling modern lighting primarily by means of demonstrations. We take small stores that need relighting and that are strategically located where other merchants can be taken to see them. In each we install a complete demonstration lighting job. We run newspaper ads showing pictures of the store interior, before and after relighting, and we take prospects to see the store in its improved condition. We worked this plan for a number of years prior to the war and feel that it is the best answer we have found to the problem of selling good lighting with a minimum of field personnel."

A second example of this kind of demonstration is the practice of another company. This company has two trucks fitted up with the fixtures and appurtenances required for outdoor lighting for showing, right on the premises, how an auto service station can be properly illuminated, a sports field lighted or a floodlighting job can be done.

Demonstration Kits and Setups

Different from this is the usual kind of demonstration more frequently employed. Kits, supplied by manufacturers or locally designed and assembled, are used to show different light sources, their manners of application, their distinctive characteristics, and their comparative costs. These kits vary from small, lightweight, assemblies that can be carried by salesmen or home service advisors on their daily calls, to large elaborate setups intended for showing to clubs, employees, dealers and other interested groups.

Less for Selling Than for Education

Indications from the replies are that, at the present time, demonstrations are used directly in selling much less than they are informatively and educatively. This, again, is a reflection of the market. There is less need now for a package to be carried right to the prospect than there will be later. Also, the sellers of lighting,

utilities as well as the suppliers and installers of equipment for it, are now busy with the larger and potentially more profitable prospects for modern lighting. They are restricted by limitations of personnel and of supply of fixtures and materials. The result is very often that they simply have not yet been able to get around to showing the smaller prospect by individual demonstration what good modern lighting is and what it can do for him.

Evidence of this condition comes from several replies stating that while they are not now being used, portable demonstration kits will be obtained and employed in selling to the smaller prospects.

Fixture Displays a Seller Duty

Except in the cases of those utilities that engage in merchandising operations, dependence is almost entirely on jobbers and dealers to display types and kinds of fixtures and lighting units. A few non-merchandising utilities have display rooms or other spaces where customers can be brought to see and select fixtures. But the general practice is to regard the display of fixtures as the function of the seller of them.

Utility Offices as Examples of Modern Lighting

Reference was made in one reply to the old adage about the shoemaker's children going barefoot. But apparently the condition of utilities strongly promoting modern lighting while their own places of business remain conspicuous examples of antediluvian illumination technique, is being corrected. Several replies stated that branch offices and salesrooms had recently been relighted and that prospects were brought to them to see different kinds of fixtures and lighting units in actual use. One utility said that its main salesroom would soon be relighted to a general intensity of 100 foot-candles for promotional effect.

Small Use of Trial Installations

Very infrequently are trial installations now being used as a selling aid. The preponderence of replies is against them as not being necessary and as being difficult because of present shortages of fixtures and materials. Some utilities said they used trial installations as a selling aid if conditions of particular cases made them seem desirable. Judging from rather meager evidence in the replies, it appears that trial installations are used in selling school lighting more often than in other fields. One reply mentions such installations made in cooperation with paint manufacturers and suppliers of chalk boards. Other frequent cooperators are parent-teacher groups and school authorities.

An interesting comment on trial installations was made in one reply. It was to the effect that as lighting comes more and more to be appreciated as a built-in function of structure design and architecture, such installations will become progressively difficult and more expensive than can be justified.

ORGANIZATION FOR SALES

Structure of, and assignment of duties in, the sales staff, relations with other interests in the field, and determination of possible buyers, are three important considerations of organization for sales of lighting or anything else. From study of the replies it would seem that, in general, lighting sales staffs are as yet far from being completely filled out; that relations with dealers, wiring contractors, builders, and architects are good but can be closer and more effective; that perhaps not enough attention has yet been given to specific classification of prospects according to their individual lighting requirements. All three of these deficiencies stem from the one cause of insufficient capable and well trained manpower.

Men Are Needed

Continually in the replies appears the statement or the plain inference that lighting sales staffs are short of what they should be for the present and future job. One company speaks of a 50 to 60 percent increase in number of salesmen. Another has 25 field men on lighting sales and would like to have 15 more. A third says its biggest present job is to rebuild its lighting sales organization. These are typical.

Differences as to Manpower Requirements

The situation as regards manpower is much confused by the lack of uniformity of ideas on what is sufficient manpower for sales. Here is the intention expressed to get down what is thought to be the reasonable figure of 2,500 customers per salesman. And there are two replies that mention 1,200 and 1,000 meters per salesman. Justifying an increase in number of salesmen, one reply analyzes the condition of 1,800 customers per man. "It should be pointed out that with an average of approximately 1,800 meters per man and with 230 full working days per year,

these men would have to average eight new calls per day to contact all of their customers even once a year. Obviously this is impossible. Four new calls per day in addition to necessary back calls would represent very efficient operation. Also contact once a year is inadequate if we are really to keep track of our customers and keep ourselves informed of what they are thinking and doing."

Specialization of Salesmen

Between the idea of salesmen devoting their time exclusively to lighting and the practice of the same men handling lighting and other sales, the replies seem to indicate about a toss-up. Some do it one way and some the other and each is undoubtedly quite sure that his way is the right one.

However, this distinction is more apparent than real at the present time. Probably the general condition is stated by two replies one of which said that lighting is now taking 75 and the other 80 percent of commercial and industrial salesmen's time. The reasons for this condition are obvious— comparatively greater present availability of lighting as against other commercial and industrial equipment and the urgency of protecting the lighting load against possible revenue loss.

Whether or not lighting sales are made by specialized or general salesmen, it seems to be the quite invariable practice to back them up with illuminating engineering talent variously designated as supervisors, engineers, consultants, etc., and with office facilities, often including one or more draftsmen, for the making of layouts and specifications.

Specialized Selling Mostly in Urban Centers

As is to be expected, salesmen handling lighting exclusively are found most frequently in utilities serving large population centers. Those power companies whose service areas are less thickly populated and contain many small towns naturally favor the general salesman idea. In some cases one utility will use specialized lighting salesmen in urban centers with general salesmen handling lighting in outlying areas.

Several replies mentioned having one trained lighting man in each district or branch office, his duty being to supervise and check the lighting sales work of the general salesmen working out of that office. Similar practice is noted in relation to the operations of district representatives where that manner of customer contact is employed.

Cooperation with Other Interests

Present activities in lighting sales have given utilities opportunity for more frequent and closer contact and cooperation with electrical dealers and contractors and with builders and architects than has been possible in recent years. Lighting men spend much time with dealers and contractors arranging for the sale and installation of fixtures and for the necessary wiring revisions of existing buildings. For provision of modern lighting in new residences and new commercial and industrial structures, they work closely with builders and architects. Here are opportunities for effective promotion of adequate wiring, electric kitchens, all the modern ideas of "electrical living."

More Might Be Done

If one thing more than another stands out from the replies, it is that the utilities are earnestly trying to make the most of this opportunity. Yet one can not escape the simultaneous impression that more might be done if time and manpower were available. There is little or no actual evidence in the replies to account for this impression; it simply results from the apparent stress on the matter of cooperation that characterizes most of the replies.

An excellent example of such cooperation is a design data sheet for residence wiring which accompanied one of the replies. This sheet is a four-page, single fold. On the front are shown the electrical symbols for architectural plans as approved by the American Standards Association; the inside pages contain a detailed reminder list of outlets for each room in the house, and wiring data on circuits, main service and conductors; on the back page is a specification form.

Classification of Prospects

So far as can be judged from the replies, about one-third of the utilities have not yet sufficiently well analyzed their markets to be sure of what lighting can be sold to what commercial customers. Some companies have carried the compilation and classification of prospect lists to a high degree of segregation of different lighting requirements; one mentions groupings into 36 classes, others seem satisfied with three divisions into food stores, dry goods stores and others. Attention to this matter varies from that indicated by the comment of one reply, "This is basic to the successful operation of any sales organization," to the statement of another that prospect lists were allowed to lapse during the war period but probably will be brought up to date.

Prospects Listed Locally

In the cases of wide-flung systems it seems to be the practice for division salesmen or sales managers to compile and maintain their own prospect lists. A good example of such practice is given in one reply:

"Division sales managers keep an active list of commercial and industrial prospects for all services. Lighting, of course, is one of the important services

to be sold to these prospects. The field people keep these lists revised and monthly summaries are made by the division sales managers and are sent to the general office of the company."

Somewhat different is the practice of another company in which the field men keep their own prospect files, reporting monthly on accomplishment. This system is not as loose as it sounds, because annual quotas of lighting sales are set for each division and thereby for each field man, who must be on his toes all the time to perform as required. He just had better find out and remember who his prospects are.

Main purpose of prospect lists appears to be for direct mail advertising rather than for the direction and control of salesmen's activities. Probably the reason for this is the present market condition, in which about as much can be accomplished by a salesman working without as with specific direction and control.

Some prospect lists, particularly those of the larger utilities, are quite elaborate and detailed. Some keep addressograph files, using the plates for mailings, with cards or folders showing the complete history and full detail of the customer's loads.

SALES POLICIES

Practice of any utility as regards sale of lighting fixtures and equipment is not necessarily an expression of its policy on merchandising. That is to say, a company that sells appliances and lamps to residential customers may be, and often is, one that does not sell fixtures and equipment for industrial and commercial lighting.

From the replies comes the conclusion that industrial and commercial lighting fixtures are not generally sold by utilities. In one or two cases it was said that the company would sell such fixtures if the customer desired. In several others it was pointed out that in small communities often there was no other way for the customer to obtain fixtures than through the utility. Opposite to the general practice of leaving fixture sales to dealers are the plans of a few companies to merchandise aggressively all kinds of lighting fixtures and equipment to all classes of customers.

Confusion in Prices and Discounts Limits Fixture Sales by Utility

One company that serves an area including many little towns and villages states its policy as follows:

"We will sell lighting fixtures of commercial types and a limited number of residential types, particularly where they are not available readily from wiring contractors in some of our smaller communities. The general price and discount structures of the lighting fixture industry are so confused that we would be somewhat limited in putting on an aggressive merchandising campaign on commercial fixtures. For instance, a customer who wants to obtain more than just a few fixtures can buy them at the same price we pay. Therefore in order to assure the sale of better lighting load, we expect to concentrate on layouts and recommendations of what the customer should have and then incidentally sell the fixtures if he wishes to buy them from us."

Fixture Orders to Jobbers

To facilitate the obtaining of fixtures by customers to whom the idea of modern lighting has been sold, one utility has set up what seems to be a workable procedure. The company does not sell fixtures. It offered a plan to jobbers whereby they will accept signed orders taken by the utility's lighting men from customers who are ready to buy fixtures. These orders will be given to jobbers selected by the customers on choices of fixtures or for any other reasons. The selling price of the equipment will include a protection of 10 percent for the contractor hanging the fixtures. This 10 percent can be obtained from the jobber by the contractor on presentation of evidence that he installed the fixtures. This plan is not intended for use in the cases of large installations, but is for the convenience of smaller commercial customers who will purchase only a few fixtures and are not acquainted with sources from which to obtain them.

Salesmen Get Bids for Customers

Frequent practice is for the lighting salesman, after an installation has been designed and is satisfactory to the customer, to secure bids from fixture suppliers and then assist the customer in deciding which to accept. This practice usually applies also to the selection of the wiring contractor who in many cases is also the seller of the fixtures.

Campaigns Will Be Frequent

It appears from the replies that many utilities will engage in aggressive campaigns to sell portable lamps, adapter units, and special kitchen and bathroom fixtures, all kinds of lighting devices that can be put into use without wiring changes as soon as such goods become available in sufficient quantity and in wattage ratings that will encourage the aggressive promotion

and sale of them. Most campaigns will be in residential lighting sales, but apparently there is plenty of opportunity for campaign selling among small commercial customers of spot and floodlights, for accent lighting. Also in this field there should be opportunity for development and supply of modern lighting designs in package units that will avoid the "peddler" appeal of lowered bills and will incorporate improved lighting for the customer with load-building value for the utility.

Lamp Bulb Campaigns

A considerable number of replies told of lamp bulb campaigns, undertaken since the end of the war, which had been conspicuously successful. Many others said that such campaigns were planned or contemplated for the near future. Non-merchandising utilities put on these campaigns in cooperation with dealers and apparently do very well with them. Employees are frequently enlisted to sell lamps in campaigns by offers of commissions and prizes for volumes of sales.

Suggests Wider Basis for Campaigns

So much enthusiasm for lamp bulb campaigns was found in the replies that the following suggestion has more force than if it stood alone. Quoting from one reply:

"Prior to the war, several very successful lamp bulb activities were carried out. They were resumed on a cooperative basis with dealers in the fall of 1945 and will probably be continued in the future. We would like to see lamp bulb campaigns planned on a state or regional or national basis. Newspaper advertisements and radio announcements of one utility penetrate into territories of neighboring companies. By having the identical campaign at the same time on a wider than one-company basis, a better job of promotion could be done and larger results obtained."

TRAINING FOR LIGHTING SALES

Component part of the problem of adequate and competent personnel, discussed elsewhere in this review of replies, training of men and women in the techniques of lighting and of lighting sales is a continuing requirement of presently multiplied urgency. "Experience has shown that good lighting men do not grow on trees," is a remark in one reply. In the pressure of the present situation, it would be fine if they did. But they don't; they must be produced by intensive specialized instruction and study, finished off with experience.

Generally Recognized as Necessary

Very few of the replies said definitely that organized courses were not being used for training lighting sales personnel and such inference could be drawn from only a small number of less definite others. Therefore it can be said that training is generally recognized as a prime requisite for selling modern lighting successfully.

Variety of Methods

There are available from manufacturers and from industry groups training courses spelled out to the last word, complete with films, canned lectures, demonstrations and schedules, all wrapped up in packages—basic courses on selling and on the fundamentals of lighting, advanced courses of specialized instruction, courses for local presentation, term courses at schools and at manufacturers' plants, personal attendance and correspondence courses, short courses and long courses. Supplementing these are quantities of printed material easily available to anyone interested. Certainly any person in the lighting business who wants to learn more about it can do so, and if he does not learn more, his failure can not be blamed on lack of opportunity.

A considerable number of replies identified by name courses taken by, being given to or planned for their employees and others. The Edison Electric Utility Institute and the General Electric-La Salle sales training courses and the Westinghouse course, "Illumination Fundamentals and Applications," were mentioned frequently. Several replies spoke of courses arranged with local groups of the Illuminating Engineering Society and of sending personnel for advanced courses of training at Nela Park.

Training and Experience Together

One reply goes into some detail on the procedure for developing competent lighting men used by a large utility:

"Our practice is to start a man as a junior lighting consultant, give him an intensive course of training at the general office for three weeks and then send him out to the district where he is to be employed.

"This initial training is supplemented by additional advanced training which is handled by the lighting engineers in their regular contacts with the men in the field. Training along the lines of company policy and procedures, rates, etc., is carried on by the district organization.

"A junior man is considered to be on probation for one year, at the end of which he is given a fairly stiff examination as to attitude, cooperation with fellow employees, reactions of customers, performance against quota, knowledge of lighting practice, and general

knowledge of company history, policy and procedure.

"The results of this examination are passed on by a board of five examiners and if the man is found qualified he is then stepped up to the grade of lighting consultant and is regarded as a permanent employee."

Training of Non-Utility Personnel

That utilities realize how desirable it is that interested people outside their organizations should have knowledge of modern lighting is abundantly evidenced by the replies. A large majority tell of training courses made available to dealer, contractor, builder and architect personnel. Frequently these people attend the courses along with utility employees; sometimes the courses are set up for them particularly. Quite common practice is for qualified utility men to act as instructors in courses organized for dealers and others, making use of selected parts of more formal instruction and of available films and demonstration equipment as well as locally developed material. This same method of locally organized courses is often used also for instruction of beginners in utility employment.

Good use is made of local electric associations and professional groups to bring modern lighting training to non-utility people. Sponsorship of sales training and lighting courses has been undertaken in many instances by electrical leagues, reaching contractors, wiremen, plant electricians and superintendents, dealers and jobbers' salesmen, and others. As for working through professional groups, one reply states, "We are fortunate in having a rather large and active chapter of the Illuminating Engineering Society here, with wiring contractors, architects, lighting equipment people and others as members, and this has been a fine means of doing educational work where it really counts."

The Job Is in Hand

One reply put it that the principal job at present is the training of company and other personnel in the techniques of lighting and sales. Another said, "We believe the emphasis is on the careful planning of lighting and the greatest contribution we can make is to push the training of the men who will do this work." It seems from the replies that the job of training is well in hand, that it is being pushed vigorously and that its results are already apparent and will be more apparent as lighting sales activities pick up speed and really get rolling.

STREET AND HIGHWAY LIGHTING

In many instances street and highway lighting is set apart from regular lighting sales, handled by department heads, by senior power sales engineers, by men especially assigned to municipal and other government contacts, or by company officers. The reasons for this are that installations are usually quite large, that practically every job stands by itself and is distinctive from the others in some ways, and that selling to a city council or other government body is different from selling to a store owner or factory operator.

Slow to Get Going

While it might be concluded from the replies that utilities generally recognize the advisability of doing something about selling street lighting, there is not much evidence in them that a great deal is being done country-wide. Part of the reason for this condition is undoubtedly difficulty in obtaining needed equipment and materials, as was remarked in a few replies.

A Few Instances

However there are several instances in the replies of real activity in building street lighting load. One says, "We have had requests for street lighting surveys in more than 50 towns and cities in our territory and we will be busy on street lighting for several years."

Another: "One man in our organization has been delegated to handle all street and highway lighting. His work is coordinated by our district managers for appearances before city and town councils and other civic groups to outline a new street lighting program and reduced rates we are offering on a contract basis. To date this program has met with nearly universal acceptance." A third says, "We have been active in promoting street and highway lighting and have several outstanding installations to our credit. These installations employ mercury units which have had splendid public acceptance."

From a fourth comes the following:

"Street lighting is effectively handled by our local representatives who offer city governments and engineers our assistance in planned street lighting. In this connection, we use a brochure we brought out last year entitled, 'A Progressive Street Lighting Plan, 194-x.' With this the city is offered a complete street lighting program set up by our representative in cooperation with the city's engineer."

Example of a Program

For its usefulness as an example of well-organized promotion, it is worthwhile to quote here the program included in one reply:

"Street and highway lighting promotion is a separate

activity with five full-time men covering specified areas. We have now embarked on a five-point program embodying:

"1. Standardization of street lighting equipment to a minimum number of interchangeable heads and fixtures, with refractors to provide lighting distributions as outlined in the 1945 I.E.S. Street and Highway Lighting Code.

"2. Modernization of older company-owned street lighting equipment.

"3. Distribution of the 1945 I.E.S. Street and Highway Lighting Code to all interested city, county and state officials. (These codes have been mailed.)

"4. Preparation of master street lighting plans for all cities and smaller communities in company territory on the basis of long-term future needs, and assistance in the budgeting of street lighting improvements.

"5. Design and installation of pendant units on modern steel standards in residential subdivisions where distribution lines are along back property line easements.

"The 1945 I.E.S. Code is the first in a series of direct mailings to civic officials on the subject of traffic safety lighting. Others to follow will explain the availability of our staff of street lighting engineers for preparing master plans, the use of the I.E.S. Code, our own modernization program and the new steel pole pendant units for suburban back property easement areas."

SCHOOL LIGHTING

In no other field, it seems, is lighting the object of such intensive and conscientious promotion as in schools. In totals, much more manpower is being used and many more man-hours are being spent in selling industrial, commercial, and other classes of lighting, because, in comparative terms of volume and of profit, school lighting is not a major part of the whole lighting business. The reason for the greater devotion and intensity of promotion in this direction is that added to the incentive of building business for profit is the animation of altruism, the feeling that an excellently worthwhile work is being done. That actually there is "something added" to school promotion is attested by the evidence of the replies; of the more than 100 of them, there are only five that directly or inferentially admit lack of interest in school lighting. And such lack may not always be blamed on the utility, as is indicated by one reply: "School lighting has not made any real headway in this place. School authorities apparently are not interested."

Cooperative Promotion

But that is not the way most school authorities feel, according to the testimony of the following quotations, which show how utilities are promoting school lighting and are receiving active cooperation from official and unofficial bodies concerned.

"We were responsible for a school lighting code which has been accepted by the State Department of Education."

"Where we can not light a whole school, we try to get modern lighting into one or two rooms in order to show the necessity of, and to create a desire for, good lighting throughout."

"We have recently completed arrangements for the installation of modern school lighting in three typical elementary rooms, designed by company illuminating engineers. These rooms are to be used as models and the plans for them have already been inspected by hundreds of people."

"We have given considerable attention to school lighting in this area over quite a period of time. Local school authorities have accepted our recommendations and raised their standards up to them."

"Special attention is being given to school lighting. Due to the extremely difficult tax revenue situation here, most school lighting has to be paid for half by school boards and the other half by parent-teacher organizations. This arrangement is being promoted aggressively."

County-Wide Surveys

"School lighting surveys have been made on a county-wide basis in a large part of the area we serve. This has been done in cooperation between county school superintendents and principals, and our field supervisors. Considerable progress is being made in the installation of improved lighting. Recognition of the need and acceptance of our response to it are much greater than we had anticipated."

"We have considered school lighting one of our most important fields. We shall continue our efforts to get adequate lighting into all schools and to keep school authorities continuously informed on lighting advances. Right along this line, we work closely with home economics and science classes and with P.T.A. groups, supplying them with educational films, lectures and literature on modern lighting."

"There is considerable interest in school lighting in Texas, resulting from the work of Dr. D. B. Harmon and his associates. The local I.E.S. chapters are also making studies of school lighting projects, and we

expect to do more than the average in this lighting field."

"School lighting has been given special attention as a great number of school districts in our area have bonded themselves for erection of new buildings and for modernization of old ones. A special report on requirements to assure minimum I.E.S. standards of school lighting has been sent to all schools in the area. These standards have been adopted by the largest school district and construction now under way will adhere to them."

"We have recently introduced lowered rates for school lighting and are engaged in an intensive campaign to push modern lighting in this field. Our activity includes a rather elaborate presentation of the need and of the benefits of improved lighting to all school authorities in our service area. We are making these presentations before group meetings of representatives of each school district. The presentation consists of informative charts, the 'Better Sight' movie, 'Light Is What You Make It,' and demonstrations of seeing conditions under various levels of illumination. Results obtained are far above our expectations."

The foregoing quotations show how school lighting is being promoted and sold, and how the utilities are getting active cooperation from other interested people and agencies. They show that the market for school lighting is one more than ordinarily receptive and that it can be developed rapidly and to benefit of all concerned.

A Most Receptive Market

Evidence of this potentiality is definitely stated in one reply:

"School lighting going forward fast. A few trial installations are working well and point the way towards many more in the next few years. In the principal city of the company territory the superintendent of public buildings has become an enthusiast on school lighting modernization and is working hard to raise the standards of schools in a community that has always had great pride in its educational facilities. If materials are available school lighting will 'go to town' in every sense of the phrase in the years 1947-1950."

OUTDOOR LIGHTING

According to one reply, lighting for sports, amusement places, parking lots, service stations, etc., has grown by leaps and bounds in 1946, and 1947 looks like a banner year.

The remainder of the replies indicate that the utilities are awake to the load-building potentialities in this field of lighting. Some have men who put full time in this work, but mostly it is the practice to assign it to one or two industrial or commercial lighting men.

Prospects Are Good

Night games in major league baseball parks have greatly stimulated the prospects in this class of lighting from corner lot and country ball field up to large city projects. Also, with war restrictions removed from use of gasoline and new cars coming gradually on the roads, competition between service stations will increase and more lighting will be sold to them.

Quoting one reply: "Considerable interest has been aroused in this territory in the use of lighting to prolong the playing hours of outdoor sports. The city has several large play areas where such sports as baseball, tennis, volley ball, archery, golf driving, shuffle board, and others can be played at night. Most of the schools outside the city in small communities have lighted football fields and, in many cases, lighted baseball fields also. These outdoor lighting applications, improved and increased parking lot lighting, and better lighting of service stations are being promoted continuously."

RESIDENCE LIGHTING

The market for home lighting consists of two definite parts, each requiring its own approach and ways of development. One part is lighting in new, and the other in existing, homes. The first requires cooperation with architects and builders and is closely bound up with the promotion of adequate wiring and with the broad theme of "Electrical Living." The second is selling new and better lighting to fit into homes where people are now living.

Must Sell the Public First

Basic to success in both aspects of the home lighting market is getting an appreciation and an understanding of modern lighting into the public consciousness. The

architect and the builder have only as much interest in home lighting as they know is justified by what the public wants. They represent the wishes of their customers, and unless those wishes are apparent to them there will be small reward from efforts to sell modern home lighting to them.

The same necessity is present in the work of selling modern lighting in existing homes. Unless the people are informed of the capabilities and characteristics of modern light sources, what can and can not be done with them for seeing and for decoration, the sale of proper and adequate home lighting will be slower than it can and should be.

Home Lighting Demand Must Be Created

The requirement of informing the public and ways to meet it are well stated in one reply:

"In the residential field our basic problem is to create a demand for better lighting. We are using the Electrical League as the natural medium for cooperating with others in the industry. In advertising some use is now being made of the newspapers and of radio. This will be expanded. We have exhibited at several local shows. Our lecture bureau has been telling the story to group meetings. Our home planning forums have emphasized lighting and we are cooperating with the Sight Saving Council. As merchandise becomes more available, cooperative advertising, window displays, greater use of motion pictures and exhibits in model homes will be added to our program. The principal personnel for home lighting promotion will be our home lighting girls. This group now numbers ten and will be increased substantially over the coming year."

The Job Is Being Done

The replies reveal that the utilities generally understand this basic requirement. This is attested to by the many mentions of home lighting advertising in newspapers and on the radio, of film showings, talks and demonstrations to women's clubs, church groups and other neighborhood social organizations. Results from such activities are not often to be seen in clear definition; the money and effort spent on them is justified by the fact that they are the only way to do the job that must be done.

An example of good work in this direction is the practice of one company:

"We carry on a year-round activity of lectures, films and interesting programs to service clubs, women's clubs and other civic and social groups. This activity is handled by a woman employee who, in addition to being our featured lecturer, supervises the bookings of the various educational films, and assists local personnel in developing lectures and obtaining engagements for them."

Another: "A major point in our activities is a vigorous and sustained advertising program on home lighting to bring about the widest possible education in the shortest possible time. We are utilizing nationally available promotional material, newspaper advertisements, radio commercials, movie 'trailers,' every sound means of accomplishing the job."

Must Work Closely With Builders and Architects

Arrangements of personnel and of methods for reaching the new home lighting market through advice and assistance to builders and architects are included in the lighting sales organizations of most utilities. Depending on the size of the company, these arrangements vary from part-time assignment of one man to highly organized groups that prepare complete and detailed plans and specifications for residence lighting and wiring.

That this work is necessary and urgent has been proven frequently by such experiences as that of one company which, checking the wiring plans for a group of 140 G. I. homes, found that the contractor was still adhering to war-time restrictions on numbers of outlets. To meet the minimum requirements of adequate wiring 30 more outlets would have to be added to the 40 provided by the contractor for a home of the particular size. Several prospective owners of these homes were interviewed. All wanted a better wiring job and were most appreciative of the company's interest.

How the Job Is Being Done

"Our company employs two men full time to work with architects and builders. Their function is to assist both in all problems relating to the use of gas and electricity. This service covers drawing up plans and specifications for wiring and assisting in the selection of proper fixtures."

"We maintain frequent contacts with architects and builders; we have an especially cooperative electrical contractors group. We check all building permits and new customer lists for prospects. We have a man on adequate wiring who covers also lighting and kitchen planning for the home."

The foregoing quotations from replies are typical of what is being done by utilities to assure that new homes will be adequately wired and properly lighted. Numerous mentions were made of certification plans and it appears clear from the replies that the work of the Adequate Wiring Bureau is getting results.

Many Ways for Selling Lighting in Existing Homes

Wide diversity of method for selling modern lighting in existing homes appears in the replies. Some utilities have, or plan to have, home lighting girls calling on customers. Others have district representatives or

home service girls who make such calls and who either have been trained to promote and sell modern lighting or are able to call in the services of experts to help them.

Other companies have no organizations for making calls in customers' homes, but have home lighting advisers who give talks and demonstrations at meetings, directing promotional work to groups rather than to individuals. Although there is no agreement in them as to method for telling the story of modern lighting to residential customers, the replies do indicate a common concern. This is that the work is worth doing and that additional personnel will be put on it as quickly as possible.

Some This Way, Some That Way

"Because of the war our home lighting department was discontinued. It consisted of 20 home lighting advisers plus clerical help and telephone solicitors. We are planning to revive this program as soon as office space and transportation become available. The new expanded program is for a department more than twice the size of our original organization. These home lighting advisers, as well as a smaller organization that provides lighting and wiring layouts for architects and builders, will specialize in their particular line and will not enter into other home service activities."

"Promotion of better home lighting is included with other home service activities. At present four girls are taking a home lighting training course. These girls are located in the four divisions of the company and will be responsible for training all other home service girls in promoting lighting."

"The promotion of home lighting is part of the job of a staff of residential salesmen and home service advisers. These people are trained in home lighting. They use pamphlets, home lighting demonstration kits and other prepared material. We made a particular point to call on all owners of homes under construction to discuss adequate wiring and modern lighting. Suggested lighting arrangements and suitable literature are left with the owner."

Home Service Representatives

"Since this company does not serve any communities of over 30,000 population we do not consider it logical to segregate lighting from other sales activities. Home lighting will be handled by home service representatives who will devote from a third to half their time to it. These representatives will be trained to make layouts for wiring, lighting, kitchens, laundries, etc. District representatives will make regular contacts each month with rural customers and will promote lighting. We are experimenting with an urban representative plan for communities of 15,000 to 30,000, who likewise will make regular monthly calls and will include lighting in their talks with customers."

"Included in our staff of home economists are home lighting advisers who call at homes for the purpose of emphasizing the importance of improving existing lighting conditions from both the utilitarian and decorative angles. When a call is made, the existing lighting in the home is measured and a written recommendation for improving it is left with the customer. This recommendation covers the sizes and types of bulbs, shades, portable lamps and fixtures. By means of a small kit of adapter units, customers are shown how present equipment can be economically converted to more efficient use. A second call is made about a month later to determine the extent to which the recommendations have been followed."

Many More Home Lighting Girls

"We have maintained a corps of home lighting girls in the field since 1936, as many as 40 and averaging about 30. This program was continued through the war period, but the group fell off to the present figure of 10 girls. We are planning to raise the number to 32 as rapidly as possible. These girls use the standard portable home lighting kits for a 1½-hour lighting survey by appointment. They also make call-backs. They make no direct sales of any kind."

"For the residential customer we suggest a lighting 'check-up;' if the check-up indicates its advisability, we go for a 'survey.' The difference between check-up and survey is only in degree. The one covers only one or two rooms, the other the whole house. Recommendations are made and the customer is urged to adopt them. We follow up later to check whether the recommendations have been carried out."

Restore Pre-War Staff

"Residential lighting is handled by our home service division. The girls are trained and equipped to make complete lighting demonstrations in the home and before group meetings. They are assigned territories of from 800 to 1,000 residential customers each. They do no selling, but work in cooperation with company and dealer salesmen. We expect to restore our pre-war staff of one director, four supervisors and 25 advisers as soon as conditions warrant doing so."

These quotations of practices for selling lighting in existing homes have been presented at some length because the matter, judging from the replies, seems to be well up front in the thinking of sales executives. At the moment, the only thing that can be done in home lighting promotion is to go forward pretty much in pre-war fashion. This is a sensible thing to do, because it will prepare the ground for the time coming when fluorescent lighting will have been developed more fully for home use. This coming time will bring with it a problem of maintaining revenue, less disturbing to utilities experienced in home lighting promotion than to those that are not.

ACKNOWLEDGMENT

This study of lighting sales practices was made possible by the interested cooperation of the following-named electric utilities, specifically, the cooperation of the men in them who responded, often in most useful detail, to our request for information. To them, ELECTRICAL WORLD expresses its appreciation and thanks.

Appalachian Electric Power Company*
Arizona Edison Company
Arkansas-Missouri Power Corporation
Atlantic City Electric Company
Boston Edison Company
California Electric Power Company
Cambridge Electric Light Company
Central Hudson Gas & Electric Corporation
Central Illinois Light Company
Central Illinois Public Service Company
Central Maine Power Company
Central Power & Light Company
Central Vermont Public Service Company
Cincinnati Gas & Electric Company
Cleveland Electric Illuminating Company
Coast Counties Gas & Electric Company
Commonwealth Edison Company
Connecticut Light & Power Company
Consolidated Gas, Electric Light & Power Company of Baltimore
Consumers Public Power District
Dayton Power and Light Company
Delaware Power & Light Company
Detroit Edison Company
Duke Power Company
Eastern Kansas Utilities Company
Eastern Shore Public Service Company of Maryland
Florida Power Corporation
Georgia Power Company
Georgia Power & Light Company
Green Mountain Power Corporation
Gulf States Utilities Company
Hartford Electric Light Company
Houston Lighting & Power Company
Idaho Power Company
Interstate Power Company
Indiana and Michigan Electric Company*
Indiana Service Corporation
Indianapolis Power & Light Company
Iowa-Illinois Gas & Electric Company
Kansas Gas and Electric Company
Kansas Electric Power Company
Kentucky Utilities Company
Kentucky and West Virginia Power Company*
Kingsport Utilities, Incorporated*
Knoxville Electric Power & Water Board
Lawrence Gas & Electric Company
Long Island Lighting Company
Los Angeles Department of Water and Power
Louisiana Power and Light Company
Memphis Light, Gas & Water Division
Michigan Public Service Company
Minnesota Power & Light Company
Mississippi Power and Light Company
Missouri Power and Light Company
Monongahela Power Company
Montana Power Company
Montana-Dakota Utilities Company
Nebraska Power Company
New Jersey Power & Light Company
New Orleans Public Service, Inc.
New York Power & Light Corporation
Northern Pennsylvania Power Company
Northern States Power Company
Northwestern Electric Company
Ohio Edison Company
Ohio Power Company*
Ohio Public Service Company
Oklahoma Gas & Electric Company
Otter Tail Power Company
Pacific Gas and Electric Company
Pennsylvania Electric Company
Pennsylvania Power & Light Company
Peoples Gas and Electric Company
Philadelphia Electric Company
Portland General Electric Company
Potomac Edison Company
Potomac Electric Power Company
Public Service Company of Colorado
Public Service Company of New Hampshire
Public Service Company of Northern Illinois
Public Service Electric and Gas Company
Puget Sound Power & Light Company
Rochester Gas & Electric Corporation
San Diego Gas and Electric Company
Seattle Department of Lighting
Sierra Pacific Power Company
Sioux City Gas & Electric Company
South Carolina Electric & Gas Company
Southern California Edison Company
Southern Indiana Gas & Electric Company
Staten Island Edison Corporation
Texas Electric Service Company
Tide Water Power Company
Toledo Edison Company
Union Electric Company of Missouri
United Illuminating Company
Utah Power and Light Company
Washington Water Power Company
Western Massachusetts Electric Company
Western United Gas & Electric Company
Wheeling Electric Company*
Wisconsin Electric Power Company
Wisconsin Power & Light Company

* Information on lighting sales operations of these companies was obtained through American Gas & Electric Service Corporation.

POLES SEASONED QUICKLY
in Hydrocarbon Atmosphere . . . II

Shortened period of conditioning in organic vapor atmosphere eliminates strength reduction entailed by steam drying—Improved penetration and distribution of impregnant obtained in Vapor Drying Process—Moisture content greatly reduced

MONIE S. HUDSON, *Chemist, Taylor-Colquitt Co., Spartanburg, S. C.*

A LARGE-SCALE TEST recently conducted for obtaining a comparison between vapor dried poles* and poles conditioned by steaming revealed a marked superiority both in strength and preservative penetration and distribution on the part of the vapor dried specimens. In this test fifty 50-ft. Class 5 pine poles in a thoroughly green condition were used. Each of the poles was cut in half to make butt and top sections 25 ft. in length. These sections were then distributed to the two processes so that when the butt section of a given 50-ft. pole was vapor dried the top was steamed and vice versa.

The poles for steam conditioning were divided into two groups, one of butts and the other of tops. These groups were then placed in regular production charges containing poles of equal size and moisture condition and were steamed and preservatively treated according to current practices. The poles for vapor drying were similarly grouped into butts and tops were vapor dried using a drying agent whose boiling point was 330 deg. F., after which they were given an empty cell treatment with creosote. After treatment 25 of the steamed sections (12 butts and 13 tops) were broken in the testing machine (Fig. 1). Mated vapor dried sections, that is, 12 tops and 13 butts, were broken at this time also. The results of this test are shown in the table as "Poles Broken at Existing Moisture Content."

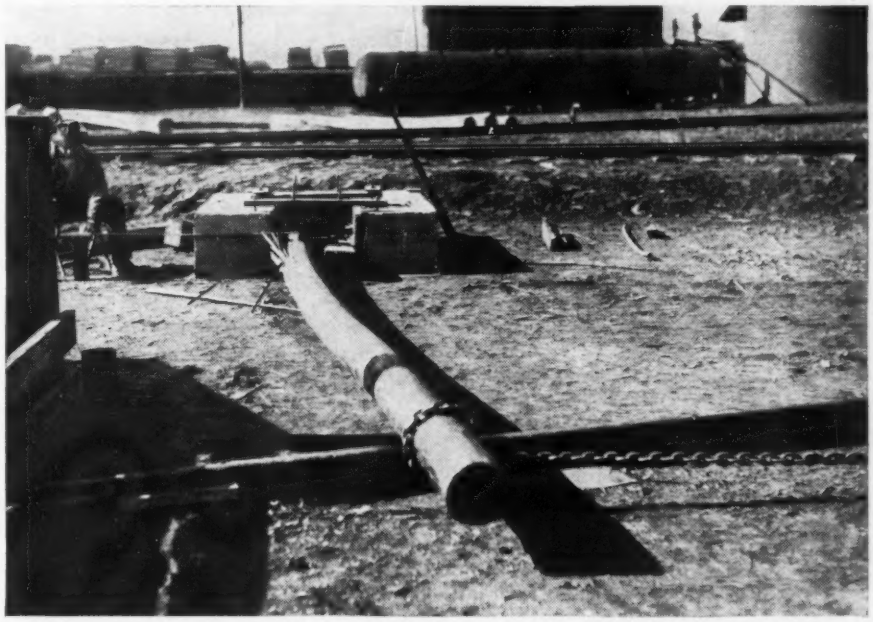


FIG. 1—One hundred poles were tested to breaking in this testing station of type designed by Bell Telephone Laboratories

* See preceding instalment in ELECTRICAL WORLD September 14, 1946, page 90.

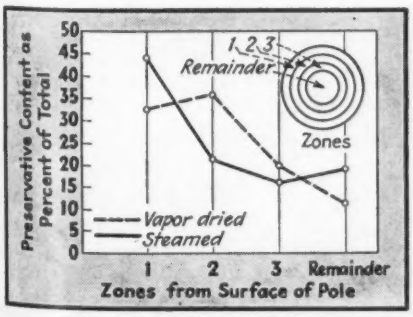


FIG. 2—Distribution of preservative in one-inch thick annuli. Vapor dried show less in first zone but more in second and third

Full Strength Retained

The remaining 25 steamed sections and their 25 vapor dried mates were subjected to a 48-hr. cold water treatment at 50 pounds per sq. in. pressure before they were broken. This was done in order to answer any criticism that might be made regarding the fact that in vapor dried poles a larger amount of the cross-section was at a moisture content below fiber saturation and therefore should show higher strength values than the steamed poles. This water treatment raised the moisture content of the entire cross-section of all of the poles above the fiber saturation point so that these test sections were fully comparable as to moisture content.

Test Results

Results of testing the poles treated in this manner are given in the table as "Poles Water Saturated Before Breaking." Since the work of Buckman and others has indicated a strength loss in the neighborhood of 20 percent as a result of steaming, the data obtained in this test indicates that vapor drying tends to cause vir-

Results of Breaking Tests on Creosoted Southern Yellow Pine Poles Prepared for Treatment: (1) by Steaming Process (2) by Vapor Drying Process

	AVERAGE MODULUS OF RUPTURE, psi.			
	Steamed Poles		*Vapor Dried Poles*	
	Butts	*Tops*	*Butts*	*Tops*
(1) Poles Broken at Existing Moisture Content	7872	6065	10130	6872
(2) Poles Water Saturated Before Breaking	7011	5885	8802	6860

tually no strength reduction because they show 20 to 25 percent greater strength than the steamed poles.

Purchasers of pine poles will also see a decided advantage in the moisture content of the vapor dried poles from the standpoint of shipping weight. Average moisture contents of the poles in the above test were as follows:

Green 87.5%
Steamed 68.6%
Vapor Dried 37.7%

In terms of shipping weight this difference in moisture content amounts to about 150 lb. on a 35-ft. Class 5 pole.

Penetration Distribution

Of equal interest is the improvement in preservative penetration and distribution in the vapor dried poles as compared with those that were steamed, shown in the photographs of discs (Fig. 3) taken from the midpoint of typical vapor dried and steam conditioned poles. Data obtained by extracting discs from the poles in this test are summarized in Fig. 2 which shows the relative percent of the total preservative found in the various zones of the poles at intervals of one inch. Whereas about 45 percent of the total preservative was concentrated in the outer inch of the steamed poles and dropped sharply in the succeeding inches, the outer inch of the vapor dried poles contained less than the second inch, which is a condition that tends to reduce the tendency of creosote to bleed from the poles.

In addition to its primary function as a drying process the vapor drying operation possesses potentialities of completely eliminating the objectionable feature of creosoted poles that so often disturbs the operator of urban lines, viz., bleeding. By subjecting the poles to a short vapor cycle after the preservative treatment, excess surface preservative is completely removed by the action of the drying agent which is an ideal solvent for creosote. Moreover the zone of wood adjacent to the surface is rendered sufficiently free of excess preservative to assure that no bleeding will occur from the pole in service. This operation can be successfully applied to creosoted poles whether they have been air seasoned, steamed or vapor dried and is conducted immediately after impregnation in the same cylinder in which the treatment was carried out.

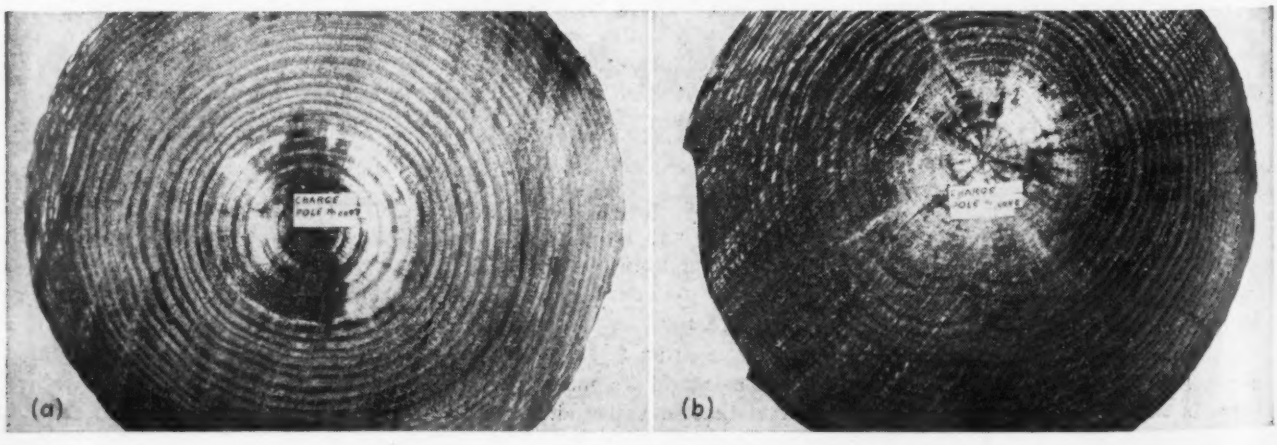
Development Continues

The possibility of using the vapor drying process for simultaneous drying and impregnation of wood is being explored at present by its sponsors. As was mentioned in connection with the discussion of the operation of the process, the wood after being vapor dried is actually impregnated with the drying agent. However, materials having boiling points at atmospheric pressure in the temperature range of 212 to 400 deg. F. would be too volatile to have sufficient permanence to protect the wood in service by themselves. It is for this reason that the vacuum after heating in vapor is usually employed to remove most of the drying agent before impregnating with creosote. If the vapor drying operation is carried out under high vacuum it is possible to use as drying agents materials whose boiling points at atmospheric pressure are very high, and since such materials are of low volatility they may be left in the wood as the preservative agent without resorting to further treatment.

Lumber Drying

Although the vapor drying process was developed in answer to a serious problem in the wood preserving industry its potentialities as a means for rapid drying of lumber or other wood products are quite evident. The work that has been done thus far, however, has for the most part been restricted to the field of wood preservation because of the extensive research program that was required in not only developing a unique process of drying timber, but also designing and adapting apparatus for its operation to wood preserving plants. Since the spade work of developing the fundamentals of technique and equipment is now finished it is expected that the application of the process in these fields will take place within a short time.

FIG. 3—Midpoint sections show relative penetration and distribution (a) for steam-dried and (b) vapor-dried poles



VENTILATING PROBLEMS
In Central Power Stations

Fan locations and associated duct layouts deserve engineering study to insure satisfactory operating conditions—Steps taken in design of steam plant to achieve employee comfort and suitable atmospheres for equipment during all seasons

E. L. BLAIR, *Chief Building Service Engineer, Stone & Webster Engineering Corp., Boston, Mass.*

SOME YEARS AGO the ventilation of central power stations was purely accidental. Stack draft or forced draft fans, if any, created a slight negative pressure within the building. Air, rushing in through open doors and windows in the summertime, provided oxygen for combustion and a cooling medium for the comfort of the operators. In the winter, when doors and windows were closed, leakage provided sufficient air for combustion, although there are cases of record where the buildings were unusually tight, and the boiler capacity could be maintained only by opening doors. The latter resulted in objectionable drafts, but the radiation loss from boiler settings, flues and other equipment was usually sufficient to keep the operators reasonably warm.

In the modern central station the volume of air required for combustion is so great and heat releases are so concentrated that ventilation can no longer be left to accident. The fans which provide air for combustion can be used to assist in the solution of the problem, but the shape and arrangement of the building usually dictates that large quantities of air must be forced into certain locations to prevent serious discomfort, or even health hazards, for the operators. A turbine room basement, located below ground, has many of the aspects of the hold of a ship, and natural ventilation is not effective, particularly when large motors, hot pipes and hot feed pumps are constantly releasing large quantities of heat to the surrounding atmosphere.

Properly located, forced draft fans can provide very effective ventilation of certain parts of the building during the hot months, but this arrangement produces serious discomfort in the winter, and may even cause freezing of water lines and other maintenance difficulties, unless arrangements are made for different methods of operation in hot and cold weather.

Forced Draft Fan Locations

There are a number of possible locations for the forced draft fans and they are not all equally favorable to building aeration:

1. The fans may be located at the lower part of the boiler room, either in the ash handling basement or on the firing floor. This is an economical arrangement, especially where preheaters are not installed, as it permits short forced draft ducts to the boilers. However, it creates a poor arrangement for building ventilation. Supplying their suction requirements creates a reduced pressure condition at the lower levels of the building which opposes the normal tendency of heated air to rise to the upper levels of the building and ultimate escape to outdoors through roof openings. It is generally impossible to provide a sufficient number of windows or other openings at the low levels to provide simultaneously for air supply to the forced draft fans and to the building for ventilation. In summer weather, this results in a reasonably comfortable condition at the firing floor but an extremely hot condition at the upper level where little or no air is moving even though a sufficient number of roof openings have been installed for ventilation.

2. The fans may be located at the upper part of the boiler room on a mezzanine floor above the boilers. This is sometimes an economical arrangement where preheaters are installed as it permits an orderly arrangement of forced and induced draft duct connections to the preheaters. This arrangement assists in providing building aeration as the supply air requirements of the forced draft fans can be furnished by providing air inlets at the low level and creating an upward air flow through the building which conforms to the normal tendency of heated air to rise. It also permits the forced draft fans to serve as building exhaust fans and reduces the requirements of roof ventilation openings. However, it locates forced and induced draft fans in an extremely hot area, which is a disadvantage for their driving motors and electrical control equipment and for the maintenance of all of this equipment.

3. Forced draft fans may be located outdoors either behind the boilers or on the roof above the boilers. In either location the fans have no effect upon ventilation unless suction duct connections remove air from the building.

Meeting Winter Conditions

The elimination of a cold boiler room in winter weather, occasioned by the forced draft fans drawing their suction requirements from the boiler room, may be solved in several ways:

a. By providing an enclosed fan room with outside louvres. This is

suitable with the fans either at the low level or the upper level of the boiler room. In cold weather the enclosed room may be completely closed off from the boiler room and the incoming cold air to supply the forced draft fan suction requirements will be confined to the enclosed room only. With this arrangement suitable protective measures against freezing are necessary for water or air lines which must be installed in the room and certain of the electrical equipment is better located outside of the room to guard against deterioration by corrosion from condensation.

b. By providing the forced draft fans with suction inlet boxes and duct connections to take air from out of doors. This is almost always feasible with the fans at an upper level, and may be convenient at the lower level also if the fan floor is at or above ground grade and the fans are located near an outside wall.

c. By locating the forced draft fans completely out of doors. This may be accomplished with the fans at ground grade or on the roof of the building.

Advanced Plant Layout

A recent installation where a large number of natural difficulties was encountered is the Venice No. 2 Power Station of Union Electric Power Co. at Venice, Ill. In this plant, designed and built by Stone & Webster Engineering Corp., the problem of providing adequate air for combustion at all times and adequate air in the right places for comfort in summer, without chilling discomfort in the winter, was solved highly satisfactorily.

The initial construction of this station included two 360,000-lb. per hr. boilers and two 40,000-kw. turbine generators. The second section included two 370,000-lb. per hr. boilers and one 80,000-kw. turbine generator. A third section, substantially a duplicate of the second, is now under construction. With six boilers in full operation, the air required for combustion exceeds 300,000 cfm. The primary problem is to be sure that this quantity of air is always available, and that it is supplied in a manner to promote comfort in the summer, but without causing discomfort in the winter. The plant is located on the east bank of the Mississippi River opposite St. Louis, and its structure is an integral part of the levee which protects the adjacent area from the flood waters of the Mississippi River. The design of the building arrangement was dictated by other considerations than ease of ventilation.

The cross-section through the building shows the location of the equipment and the relation of the component parts of the power plant; air flow arrows indicate the design basis for building aeration. The boiler house is adjacent to the river with its operating floor above the grade of the levee. Excavation for the condenser equipment of the turbines is away from the levee and is entirely below the normal ground grade. Station service transformer equipment and transformers for 33-kv. distribution across the river are located on the levee along the river wall of the boiler room, with electrical tunnels for their connections and outgoing lines located within the station adjacent to the river wall. With the electrical tunnels and the necessity of providing proper fire protection behind the transformers, only a limited number of windows could be installed in the river wall. A three-story service building adjoins the permanent end of the boiler room opposite the first boiler and blocks any opportunity for providing for inflow of air at that location except at a high level. The comparison with the hold of a ship is obvious, even in the boiler room basement, this floor being at ground level.

Natural Ventilation Supplemented

The boiler feed and other pump equipment is located in the service bay on the condenser floor behind the boilers and below the pipe gallery above which are installed several levels of water storage and heating equipment. The turbine room is constructed between the service bay of the boiler room and an electrical bay, and has no outside walls in which windows could be located except above the operating floor of the turbine room at the permanent end. Here the ship's hold analogy is complete. The major portion of all mechanical equipment is located where natural ventilation will not suffice.

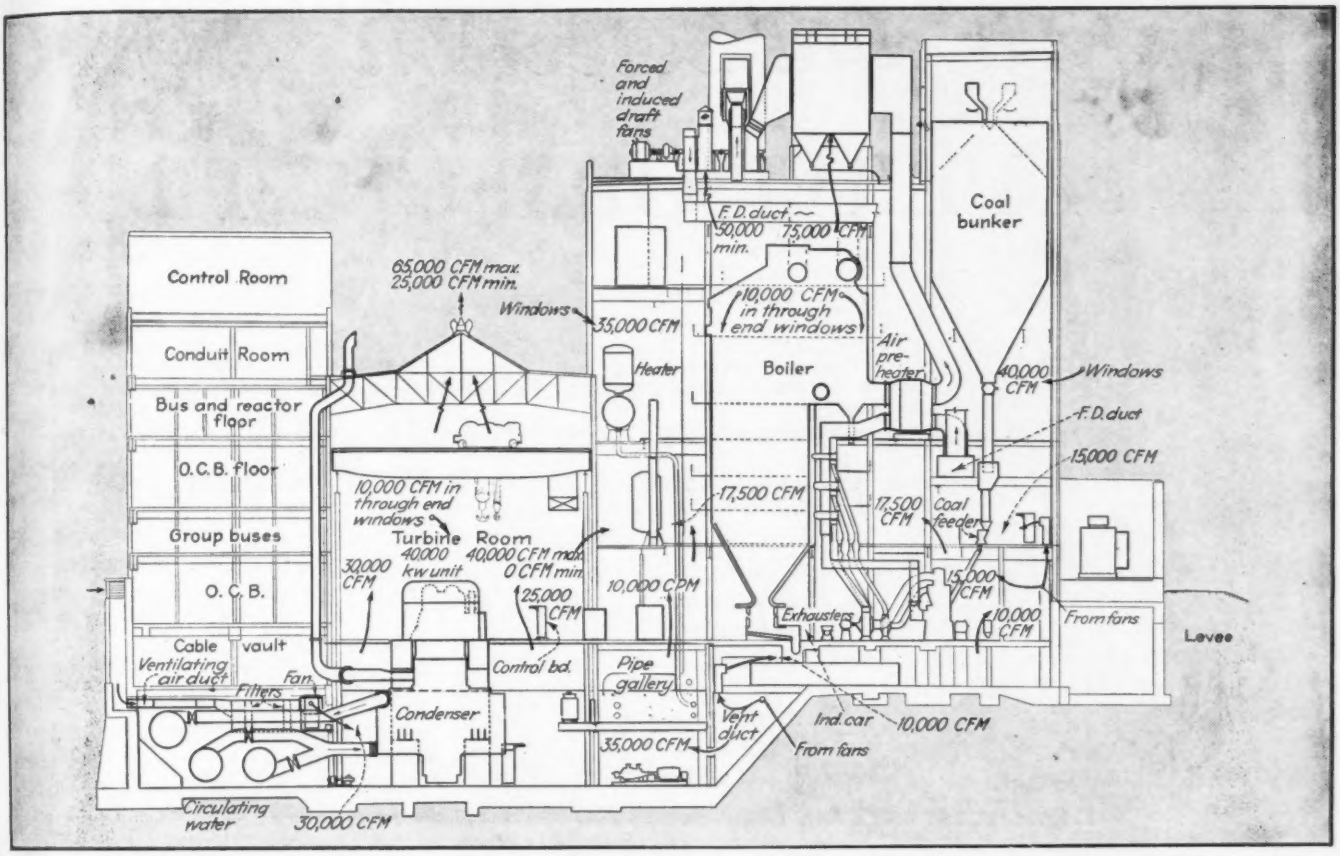
The forced and induced draft fans are located on the roof of the structure above the boilers and the forced draft fans are provided with suction boxes with dampered inlets whereby their suction requirements may be supplied either by outdoor air or by air from the upper portion of the boiler room in proportions as desired. Two forced draft fans each having a maximum capacity of 62,500 cfm. serve each boiler. In the cross-section, the forced draft fan is at the left, next to the motor hydraulic coupling drive. The short stack to the right of this fan is the air intake, taking from below, as indicated by the flow arrows, or through the hooded and louvred intake from above. Dampers in the suction ducts are manually adjusted, in accordance with the weather. It has been possible to maintain reasonably comfortable conditions above the boilers in summer, and also to withdraw enough heat from that location in winter to avoid excessively low air temperature entering the air preheater without chilling the boiler room at any level.

Locate Fans Outdoors

The outdoor location of the fans has caused no operating difficulty, either with lubrication or cooling water connections. The fact that the equipment is totally exposed to the weather has apparently inspired both the design engineers and the operators to exercise precautions which have sometimes been neglected where the fans are located in unheated enclosures, drawing air from outdoors through windows or louvres.

Flow arrows on the cross-section indicate the design air flow quantities for one 360,000-lb. per hr. boiler and one 40,000-kw. turbine generator. The supply air to satisfy the design air flow quantities is provided by a number of fans and other ventilation equipment.

A triangular shaped concrete air duct was incorporated in the concrete structure, where the high boiler room level is braced against the lower condenser room floor. The duct is behind the pump bay and provides a source of ventilation air for this area and for the pipe gallery and rear portion of the basement below the ash handling floor. A three-story fan room was constructed at the permanent end of the boiler room alongside of boiler No. 1 in which two supply fans of 90,000-cfm. capacity, each with an automatic self-cleaning type of air filter, were installed to supply air to this concrete duct serving boil-



MACHINE LOCATION and ventilation arrangements in first section of Venice No. 2 steam plant. Air quantities indicated are the approximate volumes required for one 40,000-kw. turbine and one boiler

ers 1 to 4 inclusive. A third fan of equal capacity is being installed for the ventilation of the pumping equipment which will be required for boilers 5 and 6. The discharges from these fans connect through independent galvanized iron ducts to the end of the common concrete duct.

To provide for ventilation of river side of the ash handling floor and the firing aisle in front of the boilers, the longitudinal electrical tunnel serving station service and 33-kv. transformers, which is located below the operating floor and along the inner side of the boiler house river wall, is utilized as an air supply tunnel. At the permanent end of the boiler room arrangements were provided for installing three 60,000-cfm. wall-mounted axial flow type fans to deliver air to the tunnel. For sections 1 and 2, two fans were installed at this location to supply air which was discharged from the electrical tunnel through a number of wall and roof openings to the ash handling floor and to the firing floor of boilers 1 to 4 inclusive. An additional fan is being installed for boilers 5 and 6.

For the condenser floor, which was entirely below ground grade, four 30,000-cfm. fans were installed below the cable vault of the electric bay in space which was available between circulation water connections to the condensers. These fans were provided with suction ducts connected to inlet louvres at the outside wall of the electrical bay, air filters and discharge ducts to distribute air towards motor-driven auxiliary equipment serving the condensers.

Supplementing all of this forced air supply, ventilating sash was provided wherever possible.

Adequate building aeration was secured by the omission of all interior partitions except between the electric bay and the turbine room and by reducing to a minimum the use of solid floor construction for the upper levels of the station. Exhaust for the rising air currents was provided by the suction duct connections to the forced draft fans located on the roof and by ventilating type monitors located above the aisles between boilers. A continuous heat valve on the turbine room roof permits the escape of hot air from that part of the building.

The electrical bay, consisting of several stories of equipment aisles with a top floor control room, was provided with complete supply and exhaust ventilation by the installation of fans and air ducts. Each isolated aisle was equipped with an independent supply inlet at one end and independent exhaust outlet at the opposite end from vertical air ducts installed in the stair corridors. Fan equipment was installed in an upper story fan room adjacent to the control room. All supply fans were provided with air filters and heating coils. For the control room system recirculation of the air was provided to reduce heating steam requirements. There is no recirculation of air for the electric aisle systems, as it would permit the recirculation of smoke in the event of an electric fault. Evacuation of any such smoke permits more rapid access for the repair of damage.

The ventilation system has produced a degree of comfort where operators are normally stationed which is exceeded only in air-conditioned buildings. When the heat is at its worst out of doors one experiences a distinct sense of relief when entering either the turbine or boiler room.

Analysis and Selection OF SUPERVISORY CONTROL

R. B. POLLOCK and A. A. STRAUB*

Choice of control channel becomes determining factor in selection of supervisory equipment—Open wire channels and audio frequency type of control to be installed in current ten-station program

DECENTRALIZATION of system control by the creation of a number of strategically located dispatching stations is, and has been for many years, the system planning and operating policy of the Southern California Edison Co. This has led to the demand for supervisory control equipment whereby the operators at these points can have better control of the substations under their jurisdiction.

Evolution of Program

The company's first installation of supervisory control equipment was made in 1927. Six additional units were installed from 1932 to 1934. A number of other installations were planned just prior to the war but were necessarily deferred until recently when a larger program was initiated with the purchase of equipment for ten additional substations. This equipment will be placed in operation this summer.

The unit installed in 1927 was a selector supervisory control system operating over a two-pair, lead-covered, paper-insulated, telephone-type cable. Four of the units installed from 1932 to 1934 were of the type which transmit coded direct current signals to operate a counting chain. The other two units used polarized code transmission. These six units operate over a two-conductor open-wire channel. The ten units recently purchased will transmit audio frequency signals which will operate tuned receiving relays. These use a two-conductor open-wire channel.

* Electrical design engineer and substation engineer, respectively, Southern California Edison Co., Los Angeles.

Prior to the purchase of these last ten units an engineering and cost analysis was made to determine the best type of control channel and equipment for use on this particular project. This was necessary because it was desired not only to avoid the difficulties experienced with the previous installations, but to take advantage of new types of equipment being offered. The results of this study may be of interest to others.

First, it should be pointed out that the ten substations to be supervised are widely separated, requiring a total channel length of 82 mi., or an average of 8.2 mi. for each substation controlled. Two dispatching stations were chosen, the first to control six substations with three on each of two channels, and the second to control four substations with three on one channel and one on another. One of the channels of the first group was 33 mi. long.

Selection of Channel

Where such long distances are involved the selection of the most economical and reliable channel is important. In addition to cost considerations it is necessary to select the type of channel having electrical characteristics most suitable for the transmission of the kind of signals to be used. For example: High mutual capacitance may cause excessive transmission losses of audio frequency signals, while low insulation resistance increases leakage of direct current signals.

Three types of control channels were considered, carrier current, cable and open wire.

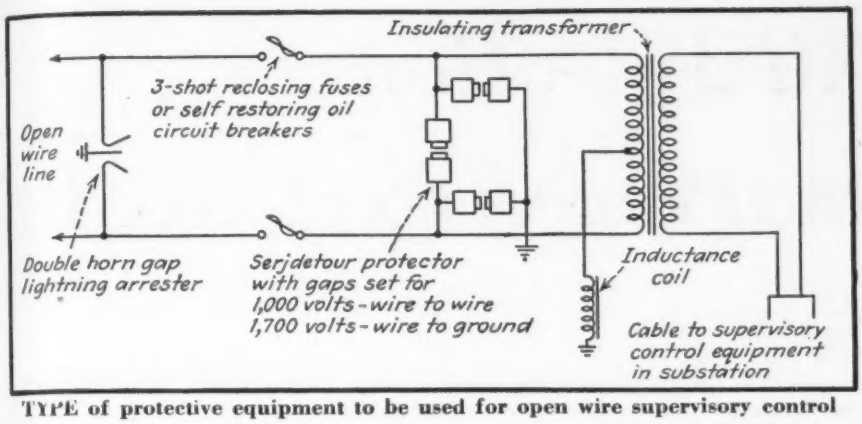
1. *Carrier Current*

Transmission of signals via carrier current over the 66-kv. lines appeared to be an economical solution in view of the long distances and the many circuits available. This method was abandoned however, because the continuity of the channel could not be assured, since the line to which the carrier was coupled might be out of service and grounded at any point while the substation was energized from another source. A considerable amount of wave trapping and by-pass equipment would also have been required and although this would have increased the cost, it was not the determining factor.

2. *Multi-Conductor Aerial Cables*

Because of some operating difficulties experienced with open wire channels in the past, it seemed at first in the current studies that cable channels were the only alternative to carrier current. For this reason considerable study was made of the various types of cable construction, the most favored of which was the steel armored, self supporting cable with 1,000-volt Flamenol insulation. The installed cost of the two pair No. 14 cable was estimated to be approximately $2,000 per mile, exclusive of poles.

Lead-covered, dry paper-insulated, telephone type cables were not considered because the low dielectric strength of the insulation has proved to be unsatisfactory for this service. This is especially true where there is exposure to a high difference of potential between substations due to line fault currents flowing through a


Insulating transformer
3-shot reclosing fuses or self restoring oil circuit breakers
Open wire line
Double horn gap lightning arrester
Serjdetour protector with gaps set for 1,000 volts-wire to wire 1,700 volts-wire to ground
Inductance coil
Cable to supervisory control equipment in substation

TYPE of protective equipment to be used for open wire supervisory control

high ground resistance. The difficulty of obtaining adequate voltage protection, even for the higher voltage insulation proposed, was considered to be an important disadvantage in the use of cable.

Synthetic Insulation

A disadvantage of synthetic insulated cables is their high mutual capacitance due to the high dielectric constant of the insulation. The 1,000-cycle transmission loss for the insulation proposed was estimated to be approximately 1.2 decibels per mile, compared to 0.75 for dry paper and 0.10 for open wires. The maximum length of cable for a 20 decibel loss would therefore be 16.6 mi. for the synthetic insulation, 26.7 mi. for the dry paper and 200 mi. for the open wires. A cable 33 mi. long with 1,000-volt synthetic insulation would therefore have a loss of 39.6 decibels, which is rather excessive for good transmission of audio frequency signals without the use of amplifiers. The effect of high mutual capacitance on direct current signals is to slow down and smooth out the impulses, thus reducing the speed and reliability of operation. These disadvantages in addition to its high cost, because of the long channels, caused further consideration to be given to the use of open wires.

3. *Open Wires*

The cost of a single pair of No. 8 copper wires, strung on existing poles and using 4-kv. insulators, is approximately $600 per mile. Thus there is a three-to-one cost advantage over cable where only a single pair is required. This is usually the case since four average size substations can be completely supervised over two wires. If however, additional pairs are needed for other purposes, the three-to-one cost advantage disappears.

Another important advantage of open wires is the high insulation value of the air and porcelain which reduces the problem of voltage protection. Exposure to induction from, or contact with, high voltage lines should be avoided wherever possible. Transpositions should also be installed where required to minimize inductive interference. Where exposure to trees cannot be avoided, they should be trimmed or the wires shielded.

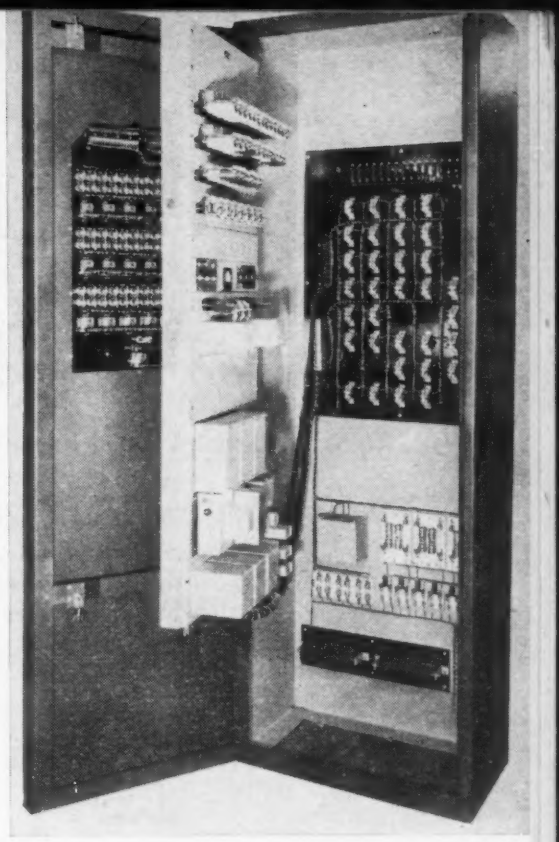
Insulating Transformers

The advantage of low mutual capacitance of open wires is offset by the difficulty of maintaining high insulation resistance between wires under wet or fog conditions. It should be noted however, that although low insulation resistance causes excessive leakage of direct current signals, it does not seriously affect the transmission of audio frequency signals. This, then, appeared to be a possible solution and further effort was directed to the use of the audio frequency type of supervisory control equipment.

Other Installations

Reports from other installations indicated that reliable operation could be expected over the 33 mi. of open wire using the audio frequency type of control equipment. It was apparent that if this could be done for the longest run, there was no justification for the use of cable for the shorter runs. The same type of equipment using open wire channels was therefore selected for the entire project.

The equipment will operate entirely through insulating transformers installed at each terminal of the channel. Frequencies from 200 to 400 cycles will be used for control; from 500 to 3,000 for maintenance communication and from 3,500 to 10,000 for indication and telemetering. Telemetering equipment will operate on the a.c. impulse duration principle. The substation bus voltage indication can be left on for monitoring the channel.



REPRESENTATIVE of type of supervisory control equipment that will be used by Southern California Edison Co. in present ten-station program; transmits audio frequency signals on open-wire channel

Protective Equipment

Protective equipment will be installed at each terminal of the channel as shown in the accompanying diagram. This equipment is the same as that used on exposed telephone lines except that three-shot reclosing fuses or self restoring oil circuit breakers will replace the usual single fuses, thus making it possible to quickly restore the supervisory control channel to service during storms or system disturbances.

It is expected that the present ten-station project will be completed some time during this year. A subsequent article will deal with the actual installation.

PITTSBURGH *Enjoins Power* STRIKERS

R. N. LARKIN, *Associate Editor*

City subordinates company and union collective bargaining desires to community's health and safety—Injunctive process halts strike temporarily—Limited court test sustains new concept

[As this article was being printed Pittsburgh experienced a power strike which began concurrently with a hearing before the Allegheny County Common Pleas Court on whether a preliminary injunction should replace the restraining order that is the subject of this article.

Further details on the strike will be found on page 119 of this issue.]

THE MILITARY AXIOM that defensive methods always arise to offset new offensive methods appears increasingly applicable to the problem of preventing strikes from disrupting indispensable utility services.

Three times this year, utility strikes which appeared inevitable were averted, at least temporarily, by state or local governments.

First of these was when New Jersey's "Edge Act" was invoked to permit state seizure of several gas plants threatened with a shutdown.

The second incident came last spring in Virginia, when Gov. William Tuck invoked authority granted in colonial days to draft men for militia duty. Employees of the Virginia Electric and Power Co. were drafted, then furloughed to their jobs. Court martial awaited those who disobeyed.

Recently, the injunctive process was used to halt a strike which had been called against Pittsburgh's Duquesne Light Co. The device was hardly as unusual as Gov. Tuck's draft, but only a little less impressive, for the use of injunctions in labor disputes has been curtailed in recent years.

The Right to Strike

Consideration of these three devices used by governing bodies to prevent strike-born disruption of utility services starts with the realization that New Jersey's "Edge Act" does not abridge the right to strike, while both the Virginia and Pittsburgh strategems conditionally did just that, although in Pittsburgh it was effective only for two weeks.

The New Jersey act authorizes state seizure and operation of utility properties threatened with strikes. This device is not new at all. It has been so widely used by the federal government as to imply public acceptance of the principle.

In Virginia and Pittsburgh, however, employees of the threatened properties were told that their right to strike was temporarily abridged. This principle fails to command the public acquiescence accorded the principle of state seizure and operation.

It would be ridiculous to assume that Pittsburgh's action heralds a return of the injunction to labor disputes. The city's action was subject to only one of three steps which Pennsylvania requires for issuance of a permanent injunction. Beyond those lie the appellate courts.

Discussion of the Pittsburgh case must consider numerous local factors. The city had been sorely disabled last February by a 19-hour power strike. The awareness of its literate residents had been sandpapered constantly for months by the enthusiastic coverage accorded the story by Pittsburgh newspapers. Union and company evidenced, through months of quite fruitless negotiation, an inability effectively to do business with each other in the absence of stronger third parties than state or federal mediators. The city administration considered the prevention of service disruption an integral part of its duties, thus spared none of its authority to achieve this end. This administration is headed by a mayor whose pro-labor predilections are a matter of long, unquestioned record. Even those nominally unenthusiastic about him credit the mayor with an intense desire to improve Pittsburgh.

Pittsburgh's request for a restraining order against any company or union action which would disrupt electric service came so shortly before the strike deadline as to seem planned for full realization of its dramatic effects. Perhaps it was. But it would be foolish to expect a pro-labor politician to invoke the hated injunction without exhausting all other possibilities. It would be naive to condemn the concealment for as long as possible of the best weapons available for the prevention of service disruption.

Little Criticism Heard

Little immediate criticism of the city's action was heard, even in such a stronghold of organized labor as Pittsburgh, and despite the drastic nature of the act. Whether an administration less demonstrably pro-labor could have done this without an overwhelming protest is questionable.

There exist two laws which might have been invoked to prevent granting of the restraining order, or, subsequently, preliminary and permanent injunctions. One is Pennsylvania's anti-injunction law, in the enactment of which Pittsburgh's mayor figured substantially. The other is the federal Norris-LaGuardia Act. Both circumscribe stringently the issuance of injunctions in labor disputes. The Pennsylvania act had been amended to withhold its provisions from cases involving violated contracts. Applica-

bility of the Norris-LaGuardia Act was questioned, although competent legal observers consider that Duquesne's status as a "public utility" under the Federal Power Act gives that normally intrastate company enough interstate character to subject the case to the Norris-LaGuardia Act.

Such considerations, however, miss the point. The city's position was that, whatever the law or its own predilections might be, a situation threatened whose concomitants were so all-encompassing, so disastrous, and so antagonistic to the public interest, that the equitable powers of the courts had to be invoked to prevent it from becoming a reality.

Two examples show the motivation of the city's demand for a restraining order. Assume a hypothetical situation wherein flood waters are sweeping down upon a community. Suppose the community were to be safe when its flood gates and dikes were properly manned and closed, unsafe when they were not so attended. Suppose the attendants were threatening strike action when the first flood warnings were received, and persisted thereafter in their strike threats.

It was the city's contention that no court would refuse to enjoin such attendants from striking during the danger period. The effects of a strike against Duquesne Light were likened to those of a serious flood. The immediate rights of Duquesne employees were likened to those of the hypothetical attendants, entirely real, but none the less subject to temporary suspension for the prevention of disaster.

Upholds Injunction Ban

Also illustrative of the city's position is this incident. The day after the city won its restraining order, the Pennsylvania Democratic Committee voted into its platform a plank opposing the use of injunctions in labor disputes. This action by the state committee sprang from the Pittsburgh case. It appeared to be a rebuff to Mayor David L. Lawrence, a Democrat whose standing in party councils is second to none in Pennsylvania. Yet Lawrence endorsed the plank, and would support legislation to achieve it. He believes that injunctions have no place in labor disputes.

The implication is plain. When the Duquesne union asserted, minutes before the strike deadline, that the stoppage would take place as scheduled, Lawrence considered that the city no longer was faced with mediating a labor dispute, but rather was required, at last, to avert a public disaster of which the labor dispute was only a part. Suddenly the cause, i.e., the labor dispute, became distinctly subordinate to the effect, i.e., the public calamity implicit in a stoppage of electric service. Protecting labor's rights became subordinate to protecting public health and safety.

Utility Position Changed

Suddenly, Duquesne Light changed from a privately owned utility to an agency rendering a service without which its area would be paralyzed. Duquesne's workers simultaneously ceased to be employees of a private enterprise and became instead "quasi-public servants," whose right to strike against so vital a public necessity could no longer be deemed superior to the impending public disaster.

Perhaps this is not good law. Certainly, at least four more legal steps would have to be taken and won before such doctrine could be asserted without fear of contradiction. All that can be said now is that such a doctrine was asserted and that it was upheld in the first legal test.

There are other interesting legal aspects. The city's complaint asserted that public utilities "which fail to render adequate and continuous service . . . by reason of their failure to maintain proper labor relations, are not entitled to enjoy the franchises granted them . . . " This refines the concept that a public utility must render good service. To render good electric service, one must also prevent service disruptions by strikes.

If the proceedings progressed to a second step, wherein a preliminary injunction was to have been sought to replace the restraining order, the court would have been asked by the city to differentiate between those of Duquesne's workers whose activity was vital to uninterrupted service and other non-vital workers. The city would not enjoin meter readers, clerical help, and similar non-operational employees, no matter how valid its right to enjoin work stoppages by employees who held life or death for city and its residents in their hands.

The handling of the legal proceedings is of interest. Several citizens had prepared complaints seeking restraining orders, then consulted the city. The city asked that they be withheld, on the ground that so drastic a measure should properly be handled by itself, not by individuals. Additionally, the city avoided the *ex parte* proceedings widely used in such cases. It had both company and union served with the complaint. It produced witnesses to testify to the material in its supporting affidavits. These precautions evidenced the city's insistence that its action was a public-protective, not a labor-punishment, measure.

Another consideration is that abrogation of the right to strike would hardly be countenanced without concurrent establishment of mechanisms to force employers to bargain and reach mutually acceptable agreements with their employees. In the Pittsburgh case, this means that if the restraining order were to become a permanent injunction and win appellate validation, Duquesne would face some mechanism not now a part of its labor relations picture.

The possibilities include compulsory arbitration, revision of its franchise, city or state seizure and operation pending negotiation of an acceptable contract, or public ownership. The efficacy of these or other measures is not an issue here.

Overshadowed by Others

It is an interesting question as to just why there was not raised in Pittsburgh an outcry similar to that which springs into being almost automatically when labor's right to strike is threatened. Perhaps public remonstrance was mitigated by a weariness of strikes. An ELECTRICAL WORLD poll last spring showed that 48 percent of those interviewed felt that strikes by electric utility workers should not be permitted, while 29 percent favored such a right.

Perhaps remonstrance by labor and the non-Pittsburgh public was stilled by the overshadowing effect of two major strikes-in-being—the East Coast truck strike, and the shipping strike.

Whatever its legal and political nuances, the Pittsburgh case is the third—and perhaps the most imposing—demonstration that strike-born disruption of vital utility services can at least temporarily be prevented by sub-federal agencies of government.

EDITORIALS

S. B. WILLIAMS, *Editor*

Relighting America Is an All-Industry Opportunity

LIGHTING is a major concern today of electric utility sales departments. New light sources have created a market for relighting that is here now, and unless that market is given the best lighting we know how to provide the customers will not be satisfied and the utilities will lose load.

Like almost every other market, however, the industry is not ready for it. For that reason equipment shortages might be a blessing in disguise for they give the utilities more time in which to recruit and train the needed sales personnel. That plans are going forward with all the speed that the times will permit is shown impressively in the special editorial feature in this issue entitled "Best Ways to Sell Best Lighting."

As before, the major responsibility for cultivating the relighting market will be assumed by the utilities, but with a greater realization than ever before that this is too big to be anything but an all-industry show. There is every reason, therefore, to expect a high degree of cooperation locally between branches of the industry.

Since the problem is pretty much the same everywhere, there is room for cooperation and unified action on the national level. In educational and sales training programs considerable has already been accomplished. Further time and expense can be saved by additional coordinated programming and promotion.

Interdependence is becoming a more familiar word in the electrical industry, but it has to be put into practice to appreciate what it means. The relighting market is ready made for a demonstration of the mutuality of interest in the industry and of how much more can be accomplished than by each hoeing just his own row. The study in the issue is but further evidence of the need, as we have said before in these columns, for some program of unification at the national level that can be translated to the local level. Whatever means are employed, and regardless of where the major responsibility will rest, it is desirable that all branches of the industry are made to feel that they are participants.

Marching together with a program and a plan the public will be better served, and the industry will receive in return a larger and more profitable volume of business.

Collaboration from Staff Groups

HEMMED IN between the public and the local politicians, between the regulators and the unions, and between Washington and the bankers the electric utility differs from almost everything else businesswise except the other utilities. It differs, too, in having a sense of public service and public responsibility often lacking with other business enterprise. That factor is an asset that is not being capitalized as fully as it might be by utility managements. It could be the spirit which, if properly encouraged and nurtured, would mean great relief to executives who are beset with problems, real and threatened.

At least the supervisory employees and headquarters staffs in general act and think as if they had dedicated their lives and their talents to serving the public in an indispensable way. One cannot record this compliment without, however, adding the expressed fear that there are places where these same primary aids to management are not too sure that their loyalty and dedication extends to the management as wholeheartedly as to the public service. They would prefer it to be an undivided and energetic loyalty but management seems not to be conscious of that lukewarm contentment. Often there are ample excuses for such situations. There would be little excuse for precipitating the issue now at a time when management is tense regarding relations with those who are organized were it not for one fact.

That fact is that management needs the whole-hearted backing and collaboration of the supervisory and other staff groups more peculiarly now than ever. There are worries about the tranquillity of the immediate future which would be softened if management could count on the backing of all but those who frame a concerted grievance. Any organization that lacks such full-measure support for its top leaders should be aware of it and move to do something about it. If it is unaware of the deficiency or believes it does not exist then executives would do well to ask questions of a few key people. The majority of utility managements will find attitudes quite satisfactory but there are manifestly some that are taking too much for granted regarding the employees in the middle and upper middle brackets while they themselves are engrossed in dealings with other groups.

Productivity of Utility Labor

SINCE 1939 the productivity of labor in the privately owned electric light and power industry has increased more than 80 percent, with the result that although payrolls are up 20 percent the unit labor costs are down some 28 percent.

These data recently released by the Bureau of Labor Statistics of the Department of Labor and covering a period from 1917 through 1945 show many interesting things. For instance, the sales of energy since 1939 were up 68 percent but the number of people employed was less

by 16 percent. Some of this employment is being recovered, but the performance of the employees during the war years gives substance to the frequently expressed opinion that the industry was overmanned before the war.

On the other hand, the increasing post-war volume, the number of new customers, and the amount of construction work to be done will need more people than were employed in 1945. Also, it will be necessary to get back to a normal work week, which is already taking place. The data show that while employment was down 16 percent, the number of man hours was off less than half as much.

Of course, in many ways these data are not true indicators of the productivity of labor. The year 1930, for instance, hit a peak in employment although energy sales had started to fall. That was the year of peak construction in the industry. In the depression when industry generally was operating with skeleton forces the lowest employment in utilities was but a little over 25 percent below the peak or approximately the same as the war-time rolls. In other words, in a service industry there is a certain necessary number of people regardless of the output. Customers require just as much service when their usage is less.

One can say with some certainty that the almost steady decline in unit labor cost from a peak index number of 150.4 in 1930 to a low of 65.9 in 1943 is over and that for a while at least the unit cost will increase. Energy sales will show some increases but so will employment figures and compensation. In fact, the 1945 unit labor cost was up nearly 9 percent from the low.

All of which is more reason for expanding sales as rapidly as possible.

Responsibility for Customer Installations

EVERY so often someone writes us suggesting that utilities withhold service from customers who refuse to accept recommendations that would assure them the best use of the service. Some of this undoubtedly stems from the fact that manufacturers can, and frequently do, refuse to sell a customer equipment that they know will not give the desired performance. They would rather lose a sale than risk having their equipment get a black eye.

People are apt to forget, however, that there is a fundamental difference between the sale of a manufacturer's product and a public service such as electricity. Utilities operating under franchise or permit are not free to withhold service if available to customers who pay their bills and who break no laws in their use of that service. If the customer had an opportunity to get the desired service from some other source it might be different, but such is seldom the case.

However, while the utilities may not exercise any powers to regulate the use of their service in the best interests of the customer, they do recognize that they cannot sidestep the responsibility to educate the customer, nor is there any desire to. The most active agent in promoting adequate wiring locally is not, as one might suppose, the contractor but the utility. In lighting, the utility has always taken the lead in promoting higher levels of better quality.

In fact, utilities realize that their responsibility goes beyond educating the customer to the advantage of good performance. They must also take the lead in educating those others who influence the customer—contractors, dealers, architects and engineers. Too often in the past have the utilities secured customer acceptance of layouts only to have them cut below good performance levels as the result of the recommendations of others.

It is perhaps fortunate that the power to police customer installations is not available, for we are convinced that more progress and greater acceptance are achieved through education. People made to want something are far better satisfied than when they have no choice.

Quality Control Ushers in New Lighting Era

AFTER a decade and a half of foot-candle lighting in which the emphasis was placed on higher and higher levels of illumination, the art is beginning to show positive signs of starting on a new cycle in its evolution, namely quality control. Evidence of this was given in a number of the papers presented last week at the annual convention of the Illuminating Engineering Society. While the authorities have long insisted that quality and quantity cannot be separated, the profession generally is now beginning to see that higher quantities of lighting are self limiting because they accent the discomfort of uncontrolled brightness.

It has been demonstrated that different objects because of their color, detail, size and background need different amounts of light for equal visibility. Likewise, it has been shown that other brightness in the field of vision as well as the relative brightness of the surroundings have a strong effect upon comfortable vision. Now the students of these quality factors are offering computations, equations, approaches and methods for weighing different factors, all of which are bound to result in better illuminating engineering and less illuminating opinion.

Most encouraging are the reports of results accomplished by fitting the surroundings to the task. Changes in floor, desk and wall colors to provide balanced brightness have not only produced better vision, but have been more efficient in light use. How far we can go in balancing brightness without reducing interiors to a monotonous sameness is still to be discovered, but with so much still to learn about brightness distribution that is not a major worry at the moment.

Emphasis on quality in no way retards the trend to higher intensities. On the contrary, the more we know about the quality factors and how to fit them together the better able will we be to achieve higher foot-candles comfortably.

WASHINGTON COMMENT

By R. N. LARKIN Washington Correspondent

The Wallace Debacle

THE DEBACLE precipitated by Henry Wallace and culminated by his dismissal from the Cabinet has the broadest implications.

Whatever these may be for our foreign policy, those regarding government relations with private enterprise are no less significant.

The Wallace Dismissal

Wallace's dismissal removes as Secretary of Commerce a man who should never have held the job. This is not a blanket condemnation of Wallace's ideas on "business," but rather an assertion that under the circumstances which prevail in fact, Wallace was unable to fulfill the functions of the job which he had accepted.

It has been asserted that it was a sorry day for the United States when the Department of Agriculture was established. Agriculture was the first cabinet department whose functions were aimed at dealing with any specific minority of the whole population. Functions of all previous departments were carried out in the interest of all the people. Agriculture, and later Commerce and Labor, became protagonists not of all the people but of blocs. No one would argue that they have not achieved valuable advances. Equally, they have sponsored minority interests without too meticulous regard for the broader interests of all. The fault is not entirely that of any one department, or the minority any represents. Moreover it did not start with the New Deal.

No Business Champion

Since various departments *do* champion minority interests, Wallace was not the man to champion "business." Whatever may have been his political stature or abilities, he simply did not possess the confidence of the minority he was designated to champion. He knew neither the words nor the music he was expected to sing. He seemed to glory in this, to take pains to emphasize it. He got his job through a bald political payoff. He took it after his enemies, whose special interests he was supposed to represent, had stripped it of its most significant functions. While "representing business," he cultivated assiduously strong political affiliations with that group which is most antagonistic to "business." Under such circumstances, Wallace could not have fulfilled the functions of the office had his been the greatest intellect and abilities in the history of man.

This assertion of Wallace's inability to represent "business" does not imply that anything unsavory is desired, or desirable, through such representation. Commerce, Labor and Agriculture can and do plead the legitimate special interests of these minorities without becoming their tools. If they can not, then they were wrongfully conceived and should not be continued.

"Confidential" Memo Case

With Wallace out "business" should be able to feel that it will not again be traduced as neatly as it was last fall when Commerce prepared a "confidential memorandum" alleging that industry could increase wages 25 percent in two years without increasing prices, yet make better profits than in 1941. The "memorandum" was made public after substantial portions of it were incorporated in the United Auto Workers' brief supporting its wage demands against General Motors. Months later, after a federal fact-finding board had taken full notice of the "memorandum," Wallace publicly announced that it was not an "official forecast of costs, prices or profits" of industry.

Politically, the implications of Wallace's dismissal are fascinating. Wallace is by no means the last of the New Dealers in the cabinet while Clark, Hannegan, Krug, Anderson, and Schwellenbach remain. But he is just about the last of what might be called the "Holy Grail New Dealers."

Where will the radical fringe go now that Wallace has been derricked —to the anguish of Democratic National Chairman Hannegan who has some elections to win in November? It just isn't possible that it will flock to a party controlled by the Tafts, McCormicks, and Pews, despite the existence therein of such men as the Stassens, Morses, Aikens and LaFollettes.

Whither Wallace

The quick answer is that the Wallace-Pepper-C.I.O.-P.A.C. crowd will form a third party. Perhaps it will, but this will have to be seen to be believed. State election laws make it almost impossible to start a national third party. State third parties can be organized, as witness New York's American Labor Party and Wisconsin's Progressives. In time, such parties could merge into a national third party. Such a merger would require more self-sacrifice than is common in politics, but our federal union sprang from a comparable situation —and one apparently deemed just as impossible in its day.

But with Wallace 58 years of age, and Pepper 46, to start such a course now would approximate a renunciation of either's hopes for continued performance in national office, particularly with any important political affiliation. Both of these men are now star ball carriers on the Democratic football team. Perhaps they will be content to start a new team and be the blocking backs whose drudgery and sacrifice will someday enable a third-party ball carrier to score the political touchdown which national office in the hands of a national third-party would represent. It is all possible, but again, will have to be seen to be believed. It would seem more logical for this group to do everything possible, now and in 1948, to establish a commanding cell within the Democratic Party. Such a cell already exists, but not in commanding strength.

NEWS OF THE WEEK

Injunction Against Pittsburgh Strikers Ends at City's Plea

Members of Duquesne Light Union had Refused to Consider Company Offers While Writ was in Effect—Strike Still on —Union President Jailed for Year for Contempt of Court

PITTSBURGH'S ANTI-POWER STRIKE injunction was dissolved shortly after noon, Thursday, by the Allegheny County Judge who issued it after city officials asked that this be done. City Solicitor Anne Alpern, who won a restraining order more than two weeks ago and a preliminary injunction Tuesday, asked the court to dissolve the injunction.

In her statement, Miss Alpern asserted that the city had been informed by union president George Mueller and members of his strike committee that the Duquesne offer made Wednesday was acceptable to the membership which had refused to consider it until the injunction was dissolved.

Mueller told reporters after the court session that he and Duquesne Light president Pressly H. McCance would meet at 3 p.m., Thursday, to discuss "an offer."

Thus the unprecedented legal battle against a power strike in Pittsburgh ended—and without any known promise that the strike would end.

Hopes of a settlement which had been raised 24 hours previously by disclosure of a new company offer were dashed Wednesday night when the union voted 1,771 to 402 against considering any offer while the injunction remained in effect.

The company offer included a 5 percent wage increase, a revision of the company pension plan to 1936 levels, with the deficit made up by the company, and continuation on a contributory basis from next January 1. The reduction from 1936 levels, effective in 1941, was made because of declining interest rates.

A vacation allowance, of one week after one year, two after three years, and three after 20 years, and an additional paid holiday, to be designated, were agreed upon. All other points of the 20 offered by the company early this month, many of them union demands, were agreed to in the new offer.

The offer was made by President Crowley of Standard Gas & Electric Co., to members of the strike committee after Mueller's incarceration.

Mueller, on the stand at Tuesday's injunction hearing, provided a dramatic climax. He admitted that he had not urged his membership to accept the arbitration agreement he had signed previously but insisted that he could neither start nor stop a strike, only act upon membership authorization. He also admitted that he had described the court's restraining order as "not worth the paper it was written on," and held to the viewpoint in court. He confessed he had announced the date of the strike which began with the hearing on the preliminary injunction, in violation of the existing restraining order.

As concluding arguments began, attorney Herman Lipsitz moved to dismiss or dissolve the restraining order. His plea was strictly upon the legal merits of the case, and he cited numerous cases in contention that the order violated a state anti-injunction act, and was unconstitutional under both state and federal constitutions.

The court dismissed Lipsitz's motions to dismiss or dissolve the order and replaced the restraining order with a preliminary injunction.

Then Mueller was called to the bar and asked whether he chose to retract his statements and apologize for them. After a long silence, he declined either. Asked if this constituted a refusal on his part to call off the strike, he agreed that it did.

He was immediately judged to be in contempt, and the court sentenced him to one year in jail and ordered him locked up immediately.

It then ordered the remaining members of the strike committee, whose identity had been forced from Mueller

(*Continued on page* 120)

Local Labor Backs Duquesne Strikers, Fights Injunction and Jailing of Mueller

ORGANIZED LABOR in the heavily industrialized — and unionized — Pittsburgh district swarmed to the cause of striking employees of the Duquesne Light Co. this week, particularly after the union president, George Mueller, was sentenced to one year in jail for contempt of court.

Despite the local popularity of the Duquesne union's fight against an injunction prohibiting any union action which would disrupt electric service to the 1,500,000 residents of Duquesne's 817 sq. mi. territory, the American Federation of Labor had not entered the case at mid-week, and the Congress of Industrial Organizations had entered only to file a brief *amicus curiae*, a move distinctly weaker than that taken by local groups, which attempted, unsuccessfully at mid-week, to enter it as co-defendants with the Duquesne independent union.

A day after Mueller was jailed, employees of the Jones & Laughlin Steel Corp. walked out in sympathy, and Local 601, of the Electrical, Radio and Machine Workers, C.I.O., called a mass meeting for Thursday if Mueller had not been released by then. The union is bargaining agent for workers in Pittsburgh's Westinghouse plants. About 2,000 workers walked out Wednesday, it was reported, after accusing the company of feeding energy into the Duquesne system from its own generating plants.

As the hearing on the preliminary injunction opened Tuesday, counsel for

(*Continued on page* 120)

Pittsburgh Homes Get Power; Industry, Commerce Curtailed

Duquesne Light Keeps 4 Plants on the Line Despite Strike —Supervisory Employees Replace Strikers—Other Utilities Aid Through Interconnections—Load Demands Drop Quickly

PITTSBURGH'S second major power strike within eight months effected substantial reductions in service rendered by the Duquesne Light Co., but it was far from leaving the city paralyzed.

Continued operation of the company's four generating plants by supervisory personnel and a few operating employees, plus interconnection with customers and utility systems, enabled the company to complete the first 36 strike hours without being forced to drop any load it was attempting to serve. Numerous industrial customers were asked to curtail early in the strike, and residential customers were urged constantly, by radio and newspaper, to make all possible economies in their use of energy. The company expressed considerable gratification at the cooperation its conservation campaign was receiving.

Commercial activities were badly crippled and much industrial activity halted in the Pittsburgh area, but the blackout never came. As often happens in power system crises, load vanished faster than capacity.

Load Figures Revealed

Hourly figures for the first 33 hours showed variations in load ranging from 410,000 kw., shortly before the strike began at 9:30 a.m., September 24, to 107,000 kw. at 3 a.m., September 25. The 9 a.m. September 24 load was substantially below that of the comparable hour one week earlier, which was 514,000 kw.

Load figures for the first 33 hours were as follows:

September 24—8 a.m.—366,000 kw.; 9 a.m.—410,000 kw.; 10 a.m.—320,000 kw.; 11 a.m.—281,000 kw.; noon—229,000 kw.; 1 p.m.— 226,000 kw.; 2 p.m.—225,000 kw.; 3 p.m.—208,000 kw.; 4 p.m—199,000 kw.; 5 p.m.—185,000 kw.; 6 p.m.—180,000 kw.; 7 p.m.—179,000 kw.; 8 p.m.—227,000 kw.; 9 p.m.—220,000 kw.; 10 p.m.—219,000 kw.; 11 p.m.—188,000 kw.; midnight—153,000 kw.; 1 a.m. September 25—131,000 kw.; 2 a.m.—108,000 kw.; 3 a.m.—107,000 kw.; 4 a.m.—107,000 kw.; 5 a.m.—110,000 kw.; 6 a.m.—112,000 kw.; 7 a.m.—139,000 kw.; 8 a.m.—164,000 kw.; 9 a.m.—183,000 kw.; 10 a.m.—198,000 kw.; 11 a.m.—202,000 kw.; noon—178,000 kw.; 1 p.m.—199,000 kw.; 2 p.m.—191,000 kw.; 3 p.m.—190,000 kw.; 4 p.m.—184,000 kw.; 5 p.m.—174,000 kw.; 6 p.m.—170,000 kw.

Loads at comparable hours a week earlier included the following: September 17, 8 a.m.—456,000 kw.; 9 a.m.—514,000 kw.; 11 a.m.—526,000 kw.; 8:35 p.m.—497,000 kw.; September 18—8 a.m.—450,000 kw.; 9 a.m.—511,000 kw.; 11 a.m.—537,000 kw.; noon—489,000 kw.

When the strike began, coal supply at the four generating stations ranged from 36 hours to an undisclosed maximum. Some unloading was done at at least two stations after the strike began.

A citizens committee formed two weeks ago when the strike first threatened promised to send "skilled personnel" to the company's aid to help operate the generating stations if necessary. It was known that some engineers in the city had been asked to fill in questionnaires indicating their ability to be of service to the company, but this was not a Duquesne move.

Local Labor Backs Strike, Fights Jailing of Mueller

(Continued from Page 119)

Pittsburgh's Central Labor Union, A. F. L., and the Pittsburgh Joint Council of Teamsters, had attempted unsuccessfully to intervene as co-defendants.

Earlier, the C.L.U. had sent telegrams to all western Pennsylvania Democratic candidates for state legislature asking their stand on the use of injunctions in labor disputes. The move, apparently, was abortive, as many candidates supported Pittsburgh's Mayor David Lawrence, who obtained the restraining order and later the preliminary injunction.

Lawrence is second to no Democratic leader in Pennsylvania, both in prestige and power. His involvements in the injunction issue threatened to make it a hot political issue in Pennsylvania this fall. Lawrence seemed, at mid-week, to have lost some rank and file labor support despite his long reputation as a pro-labor politician. Any such loss, it was agreed, was offset by support gained among the general public for his repeated attempts to prevent a disruption of electric service.

The injunction was attacked furiously by the Steel City Industrial Union Council, C.I.O., which called a general membership meeting and threatened a general strike of C.I.O. workers in the Pittsburgh district.

In addition, the American Civil Liberties Union entered the case with a blistering attack upon the court order which, it charged, "establishes forced labor."

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Injunction Against Pittsburgh Strikers Ends at City's Plea

(Continued from page 119)

for the first time during the hearing, to appear in court Wednesday morning to answer a contempt citation which grew out of their part in announcing the strike in violation of the restraining order.

When court convened, Wednesday morning, the committee asked a 24-hour continuance so that a membership meeting could be called for Wednesday night, when Crowley's offer would be submitted. The strike was to end immediately if the offer was accepted by the union.

Each member of the strike committee was called to the bar and sworn to present the offer to the membership in its best light, and to "urge and recommend" its acceptance. Later in the day, Mueller appeared in court with his apology and was released in custody of his attorney to attend the meeting and urge acceptance of the offer.

Reporters covering the story were told by various sources that President Mueller and the committee members had presented the company offer enthusiastically and urged its acceptance. After discussion was completed, the concensus had it, a motion was quickly made from the floor that no offer be considered until the preliminary injunction issued by the court be removed. Voting followed, and the settlement opportunity was lost by a four to one margin. It seemed reasonably certain that the company's offer had not been rejected, just not acted upon.

Offer of Omaha P.P.D. to Buy Nebraska Power Accepted

Purchase Price of $43,747,530 Includes Iowa Properties Which Must Be Sold—30-Day Delay in Sale Mandatory—Bonds with Low Interest Rate Will Be Issued to Finance Transaction

PUBLIC OWNERSHIP of the Nebraska Power Co., once a subsidiary of the American Power & Light Co., seemed assured last week when the Omaha Public Power District, created in 1945 by the Nebraska Legislature, offered to purchase the utility from its present owners, the Omaha Electric Committee, Inc., a non-profit group which purchased the utility in December, 1944.

In the purchase agreement filed with the Nebraska Department of Public Roads and Irrigation, where it must remain for 30 days unsigned and open for public inspection, the total price is placed at $43,747,530 for all properties and assets of the utility.

Certain properties of Nebraska Power are located in Iowa, and these the Omaha P.P.D. will have no authority to operate. To solve this problem, an Iowa company will be organized to purchase the properties in that state. It is estimated that the value of these, along with the current assets of the entire system including such items as cash, government bonds, and saleable merchandise, is approximately $6,000,000. At this valuation, the cost of the Nebraska portion of the utility would cost the P.P.D. $37,747,530.

When the transaction is completed (present indications set December for this) Nebraska Power will be liquidated, and all Nebraska property will then be owned by the P.P.D., which will operate the system.

Bond Interest Will Be Lower

The district will issue revenue bonds to cover the purchase price; these bonds would carry a much lower interest rate than those of the present utility, a part of whose preferred stock now carries 7 percent. It is from the saving on interest, the absence of stock dividends, and exemption from federal taxation that the P.P.D. expects to secure the money to retire the bonds.

Burns & McDonnell, Kansas City, engineering consultants for the Omaha district, have estimated that the net revenues, excluding the Iowa properties, that would be available for debt retirement, payment of interest on the bonds, and accumulation of a reserve for plant additions would in 1946, under public ownership, be $4,910,000. The amount that could be applied to debt retirement cannot be calculated until financing arrangements are complete.

The Iowa properties will continue under the operation of the Omaha Electric Committee until the new Iowa company can be formed to take over. This may lead to a struggle similar to the seven-year battle in Nebraska.

Council Bluffs, largest city served in that state, will be the center of the new struggle as Nebraska Power's franchise in that city expires next year. The Chamber of Commerce in that city has had a ten-man committee watching the situation for some time, but it has taken no official stand.

In Lincoln, last week, the Omaha P.P.D. won another court battle when State District Judge John L. Polk ruled that it is a constitutional public power district and a political subdivision of the state. He made this ruling in dismissing a petition of Louis F. Armbrust, Gretna, Neb., for an injunction against the formation of the district and to have the law creating the district declared invalid.

Northwest Power Loads Crowd BPA's Facilities

The Interior Department found a new power shortage in the Northwest last week and called for installation of additional generating capacity at Grand Coulee Dam as rapidly as possible.

Administrator Paul J. Raver, of the Bonneville Power Administration, asserted that the immediate problem, resulting from a demand which is scheduled to reach 140,000 kw. at the Troutdale, Ore., plant of Reynolds Metals Co., will cut back on sales of dump energy to private systems in the region, with a consequent increase in operation of the steam-electric facilities owned by these companies.

In Washington, Interior Secretary J. A. Krug said the situation demanded additional capacity as rapidly as possible and added that "present overloads" on BPA's transmission grid are "equally critical."

Krug said BPA's post-war peak reached 1,144,000-kw., September 12, closing in on the war-time peak of 1,427,000-kw. An additional 32,500-kw. load was to come on at Henry Kaiser's Spokane plant, and the 140,000-kw. load at Troutdale would close the gap even further. Removal of two units from Grand Coulee for return to Shasta dam has cut the system's capacity to 1,176,400 kw., and limits its peaking capability to 1,300,000 kw. In addition, two machines are now down for overhaul, one at Bonneville and one at Grand Coulee.

Raver asserted that, in addition to the shipyards whose load totalled only

RUSH VETERANS' SERVICE—Boston Edison Co. employees set about 40-watt-hour meters during a recent weekend to enable tenants of the first completed temporary homes in the Columbia Village development for veterans in South Boston to move in. To date 281 meters have been installed at the project

42,000 kw., only three war-born major power users remain to be disposed of in the BPA area. These are the Tacoma Aluminum plant, soon to be leased, with a demand of 42,000 kw.; the Wenatchee, Wash., ferro-silicon plant with 22,000-kw. demand, and the Spokane magnesium plant with a maximum war-time demand of 45,000 kw.

Much of the loss in war loads, Raver added, was quickly absorbed by distribution agencies "which are continuing to experience a remarkable load growth."

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40,000-Kw. Unit Ordered by New Jersey Power

New Jersey Power & Light Co. has placed orders for the installation of a 40,000-kw. turbo-generator unit at its Gilbert steam plant at Holland, N. J., on the Delaware River. This will bring the total capacity of the plant to 95,000 kw.

The new unit is scheduled to be in operation by the fall of 1949 on the basis of delivery of the unit by November, 1948.

The company's $3,000,000 construction program, announced in February, has been greatly retarded by delayed deliveries of material. Construction totaling only $550,000 was completed in the first six months of this year. If deliveries improve, the total for the year may reach $1,400,000.

By August 1, the company had built 95 miles of new lines and added over 700 customers.

The new high-voltage line from the company's West Wharton substation to the Whippany generating plant of the Jersey Central Power & Light Co. is almost complete. This will provide another major interconnection to improve service throughout the area.

Work has started on a new substation at Hackettstown; others will be erected at Rockaway, Sussex, Branchville, Lyons, and Lake Hopatcong.

Work is underway in Sussex County to build a transmission line from Hamburg to supply the new substation at Sussex.

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20-Year Franchise Voted

In a special election, Florida Power Corp. was granted a 20-year franchise by New Port Richey, Fla. The new contract provides for the payment by the utility of 2 percent of the gross receipts from the sale of all power in the city except that sold for municipal and industrial uses. The old franchise provided for no such payment.

Arizona Utility Refuses to Allow Probe by FPC

Claims State Corporation Board Has Sole Jurisdiction — State Also Wants to Investigate Rates

The long battle between Arizona utilities and the state over an investigation of power rates was broadened last week when Central Arizona Light & Power Co. flatly refused to cooperate with an investigation planned by the Federal Power Commission.

Through its executive vice-president, Henry B. Sargent, Central Arizona advised FPC that it "is conducting its business in accordance with the understanding and belief that exclusive jurisdiction with respect to its business and system of accounts lies with the Arizona Corporation Commission, and that the company is not subject to the jurisdiction of the Federal Power Commission or its uniform system of accounts."

This action followed notification by FPC that it contemplated "starting on September 25, a field examination of the plant accounts of your (Central Arizona Light & Power Co.) company, pursuant to the reclassification and original cost provisions of the commission's uniform system of accounts. Our staff will consist of three accountants and one engineer, and it will be appreciated if suitable office space is arranged for them."

Governor Wants Rate Study

Gov. Sidney P. Osborn has long been anxious to have a rate study made of utility companies in the state. Because the Arizona Corporation Commission has neither the manpower nor funds for such investigations, the governor in 1945 succeeded in having the legislature appropriate $50,000 to pay for an investigation by FPC. A move was begun immediately for a referendum of the voters on the appropriation. When the secretary of state refused to include the referendum on the ballot, its advocates went into court, won a victory in the lower court, lost in the Arizona Supreme Court, and now are preparing an appeal to the U. S. Supreme Court.

When Yale McFate, acting chairman of the Arizona commission, telephoned Leland Olds, FPC chairman, to learn exactly what relationship FPC's contemplated field examination of the Central Arizona firm bore to the expected statewide rate base study, he was informed by Olds that the examination "is in connection with and under our regular authority over utilities that sell or transmit power in interstate commerce" and not in connection with the rate survey of the Arizona commission.

Olds said that the commission expects to proceed with its announced intention to begin a field examination of the plant and accounts regardless of the utility's expressed opposition but failed to indicate how FPC intends to get at the records and accounts of the utility.

McFate also announced, following his conversation with Olds, that "the legal staff of the Federal Power Commission and the Corporation Commission is considering whether the appeal to the Supreme Court of the United States (which opponents of the state's probe of power rates have announced they are taking) presents a moot question of whether we should proceed immediately with the survey."

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Illinois Power Co. Plans $18,000,000 Steam Station

Illinois Power Co., Decatur, has applied to the Illinois Commerce Commission for authority to construct a steam generating plant on a site along the Mississippi River in Madison County about two miles below Alton and near Wood River, Ill. The plant is to cost approximately $18,000,000. New stocks or bonds are to be issued to finance the construction.

Three 40,000-kw. steam-turbine generating units are planned. The output would serve customers in the area extending from Madison County, just across the Mississippi from St. Louis, to points beyond Hillsboro, Mount Vernon, and Sparta. Coal will be used for fuel.

H. E. Steinhoff, vice-president, said that the utility plans to link the proposed Alton plant with the plant now under construction at Havana. This plant on the east bank of the Illinois River will have two 40,000-kw. units and will cost over $11,000,000. The Havana plant will relieve Illinois Power from purchasing electricity for its northern division from Commonwealth Edison Co. of Chicago, and other utilities.

Allen Van Wyck, president of Illinois Power, said that the company has made no arrangements as yet to terminate its contract with the Union Electric Co. of Missouri to purchase power for its southern division from that company's plants. It is understood that this contract runs until 1967.

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30,000-Kw. Unit Planned

The United Illuminating Co. has announced plans to add a 30,000-kw. unit to its English station in New Haven, Conn., raising the capacity to 105,000 kw. Total cost of the unit, auxiliary equipment, building, and construction will be $840,000.

Instrument Society Sponsors First Exhibit at Pittsburgh

102 Firms Show Hundreds of Products, Many Perfected or Created for War Production—50 Informal Papers Presented at Technical Sessions—C. O. Fairchild Elected President

PRONOUNCED electronic flavor marked the first instrumentation exhibit of the Instrument Society of America at Pittsburgh, September 16-20. Shown by the 102 exhibitors were hundreds of products, many created or perfected for war production and many shown for the first time. Discussion with the producers indicated that numerous other developments are being perfected, all heavily in the direction of regulating and improving industrial controls and operations through instrumentation.

A 30,000-sq. ft. area of William Penn Hotel space had been set aside for the exhibits and a group of meeting rooms on the same floor afforded accommodations for the 50 informal papers on the 20 technical sessions of the newly organized society. The ASME and the local physical society had companion programs. Registration at the exhibit was 850 on the opening day.

C. Owen Fairchild, consulting physicist of Queens, New York City, was elected president. Other officers are: vice-president, C. F. Kayan, Columbia University, New York; H. H. Barnum, consulting engineer, Detroit; R. D. Munch, Monsanto Chemical Co., St. Louis; and J. B. McMahon, Kellex Corp., Chicago; treasurer, H. E. Ferguson, Peoples Gas & Coke Co., Chicago; secretary, Richard Rimbach, publisher of *Instruments*, Pittsburgh.

Newest Items Exhibited

Significant among the newest items exhibited were the following: an electric-eye counter (1,000 per minute) with remote indication (by Autotron Co.); a magnet comparator on flux-meter principle, a sensitive frequency meter with alarm for departures, and rmount for stop-watch on viscosimetry tests (all three by J. G. Biddle Co.); a stress-strain recorder that plots 48 diagrams simultaneously (by Connecticut Telephone & Electric Co.); a leak detector for freon, methyl, and other refrigerants (Davis Emergency Equipment Co.); appliance tester to determine working temperature and electric conditions of ranges, refrigerators, freezers, etc. (J-B-T Instrument Co.)

General Electric Co. displayed a new gauss meter, a heat-radiation meter, a flaw detector for sheet material (cable tapes, wire enamel, etc.), a pipe thickness gauge on magnetic principle and a unit to register radioactivity in conjunction with a Geiger counter. Radiation indicators and Geiger counters (including pocket patterns) were on the list of Victoreen Instrument Co. which also showed a new line of small vacuum tubes for incorporation in industrial instruments. A new line of industrial relays was exhibited by RBM Division of Essex Wire Co.

Shown by Rome Radio Research Laboratory Co. were an electronic spark-plug analyzer available for oscilloscope detection of corona and insulation breakdown, a moisture-content comparator for paper and fabric, and a "watchman's protector" in radio-code form. A proportional mutual conductance tube checker for industrial electronic maintenance and a maximum-minimum bimetallic thermometer were two new instruments at the Weston Electrical Instrument Co. booth. An electronic micrometer for determination of insulation thickness was announced and shown by R. M. Wilmotte, Inc. Waterman Products Co. had a 6-lb. "pocketscope" with small cathode ray screen for checking harmonics, synchronism and phase angle visually. A quartz-crystal-controlled electronic device times watches in a 15-sec. interval for accuracy was shown by Henry Paulson & Co.

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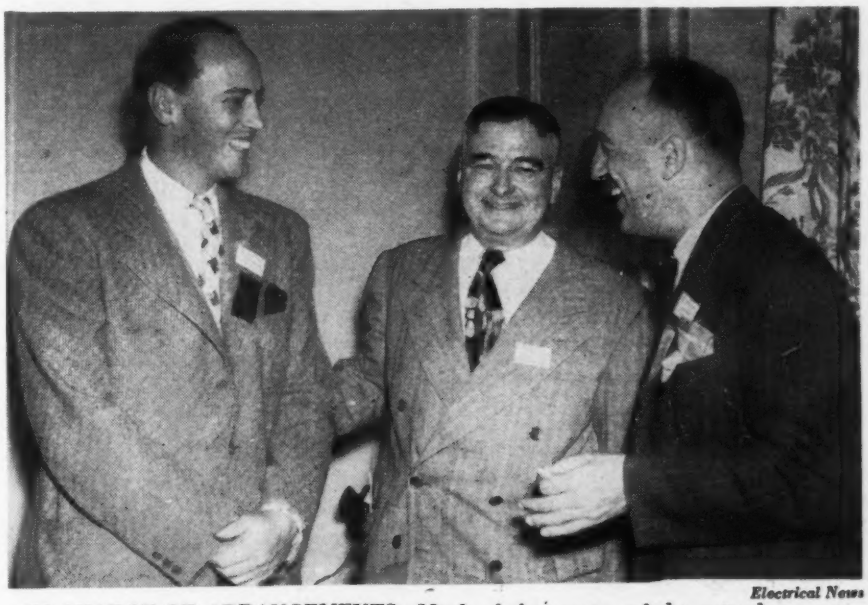
Cowlitz County P.U.D. Will Acquire Utility Properties

Cowlitz County Utility District in southwestern Washington has announced that it will go ahead with the acquisition of Northwestern Electric Co. properties near Woodland and Kalama, Wash., under terms of a verdict in recent condemnation proceedings in Cowlitz Superior Court.

The P.U.D. has deposited $493,215 with the court to satisfy the jury's verdict. This sum represents a part of the $813,000 realized from the sale of revenue bonds to John Nuveen & Co., Chicago. The remainder of the money will be used in a rehabilitation program, including modification of boilers in the P.U.D. steam generating plant.

The budget adopted by the district also lists a possible acquisition expense of $1,750,000 in the event the P.U.D. buys the Puget Sound Power & Light Co. holdings in Cowlitz County.



Electrical News

IN CHARGE OF ARRANGEMENTS—Much of the success of the annual convention of the Illuminating Engineering Society held last week at Quebec was due to A. H. Manwaring, left, Philadelphia Electrical & Manufacturing Co., chairman of the National Convention Committee; President A. F. Wakefield, F. W. Wakefield Brass Co.; and F. E. Rinfret, Solex Co., Ltd., chairman of the Executive Committee of the convention

Utilities Indicate Forceful Home Lighting Promotion

If the electric utility industry is successful in its efforts, the American home is going to be relighted. A survey just released by the Home Lighting Committee, Commercial Division, Edison Electric Institute, indicates that utilities will be far more aggressive in promoting home lighting in the coming year than in any previous period.

The survey, which is based on reports from 87 companies serving 48.3 percent of the total residential and farm customers in the nation, is entitled "Utility Home Lighting Promotion, 1946-47" and sells for 40 cents a copy at the Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.

The promotion methods to be used are explained in the survey. Of the utilities reporting, 84 percent will furnish home lighting advisory service, with specially trained employees calling at customers' homes. Promotion of home lighting through dealers will be developed by 73 percent of the companies, and 53 percent will sell lighting equipment to customers, in conjunction with dealer cooperative plans.

Newspaper advertising of home lighting will be employed by 83 percent of the utilities, and radio advertising by 52 percent. The new certified portable lamps will be advertised by 85 percent, and 71 percent will advertise certified home lighting fixtures.

Utility plans for promotion through dealers which are discussed in the report include educational meetings for trade groups, sales campaigns on specific types of equipment, and the supply of display materials for use by dealers. Sixty-five percent of the utilities will promote home planners' groups, which will organize customers who plan to build homes to hear discussions on home design, building, and financing by experts in these fields.

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Grand Island, Neb., Buys P.P.D. Distribution System

The Consumers Public Power District has sold its distribution system in Grand Island, Neb., to the city along with that serving St. Libory, north of Grand Island, for $449,164. Grand Island will also pay $1,875 to cover its share of the 1946 payment in lieu of taxes due on the property sold.

Under the ten-year contract made, Consumers agrees to furnish power to Grand Island on the basis of 1,500 kw. of firm capacity. The city agrees to buy a minimum of 450,000 kw.-hr. monthly and a yearly minimum of 7,000,000 kw.-hr. at the district's standard wholesale rate.

Consumers will retain its substation and transmission line facilities in Grand Island which serve that area. It will also retain a power plant, storeroom, and office property.

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$1,000,000 Building Plans Revealed by Indiana Utility

Expansion plans calling for the expenditure of more than $1,000,000 have been announced by the Indiana Service Corp., Fort Wayne. Work is to be started before November 1 and completed within a year and a half.

Included in the plans are a new 45,000-kw. substation at the present Lincoln switching station in the industrial section of Fort Wayne and two new 34-kv. high tower transmission lines around and immediately beyond the Fort Wayne corporate limits to tie the new capacity of the Lincoln station to the present McKinley substation on Miller Road.

The plans also call for the Indiana & Michigan Electric Co. to make an additional tap in its present line north of Fort Wayne to bring a new 132-kv. double circuit line into the city.

Monongahela Power Plans New 50,000-Kw. Station

Monongahela Power Co., Fairmont, W. Va., has announced plans to construct a new 50,000-kw. generating station on a site between Parkersburg and St. Marys designed to serve several new industrial plants in the area and to meet further industrial expansion.

Initial cost of the plant will be $11,000,000 and ultimate capacity is expected to be 150,000 kw. Within the next five years, the company expects to spend between $25,000,000 and $30,000,000 on additional betterments to facilities of which the new Parkersburg area power station is a part.

The new station will be close to the vast new industrial plants of du Pont near Parkersburg, B. F. Goodrich at Marietta, Ohio, and the American Cyanamid near St. Marys. Growth of northern West Virginia as an industrial area also has necessitated the production of additional power and, with the principal Rivesville station running at capacity continuously and somewhat limited in expansions which might be made, it was decided to locate the new station in the Parkersburg division on the Ohio River to best serve that immediate territory and reduce the pull on Rivesville's output.

MEETINGS

Previously Listed

International Association of Electrical Inspectors—Southwestern Section, Hotel Sacramento, Sacramento, Calif., September 30-October 2; Southern Section, George Vanderbilt Hotel, Asheville, N. C., October 14-16; Western Section, Gibson Hotel, Cincinnati, Ohio, October, 21-23; Eastern Section, Mark Twain Hotel, Elmira, N. Y., October 28-30.

American Society of Mechanical Engineers—Fall meeting, Statler Hotel, Boston, Mass., September 30-October 2.

Pennsylvania Electric Association—Annual meeting, Wm. Penn Hotel, Pittsburgh, Pa., October 1-2; Electrical equipment committee, Lord Baltimore Hotel, Baltimore, Md. October 24-25; Transmission and distribution committee, Abraham Lincoln Hotel, Reading, Pa., October 24-25; Meter committee, Benjamin Franklin Hotel, Philadelphia, Pa., November 7-8; Systems operation committee, Skytop Lodge, Pa., November 7-8.

Edison Electric Institute—Meter and service committee, Hotel Roosevelt, New Orleans, La., October 1-3; electrical equipment committee, New Ocean House, Swampscott, Mass., October 4-5; prime movers committee, Hotel Roosevelt, New Orleans, La., October 6-7; transmission and distribution committee, Cavalier Hotel, Virginia Beach, Va., October 7-8; accident prevention committee, Hotel Statler, Buffalo, N. Y., October 31-November 1.

International Association of Electrical Leagues—Annual conference, Astor Hotel, New York, N. Y., October 2-4.

Southeastern Electric Exchange—Engineering and Operation Section, Henry Grady Hotel, Atlanta Ga., October 3-4; Accounting Section, Fort Sumter Hotel, Charleston, S. C., October 17-18; Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., November 6-9.

National Electronic Conference—Second annual conference, Edgewater Beach Hotel, Chicago, Ill., October 3-5.

American Institute of Electrical Engineers—Great Lakes District, Claypool Hotel, Indianapolis, Ind., October 9-11.

National Electrical Contractors Association—Annual meeting, Ritz Carlton, Atlantic City, N. J., October 14-18.

Electrochemical Society—Fall meeting, Royal York Hotel, Toronto, Canada, October 16-19.

ASME-AIME Joint Fuels Conference—Bellevue-Stratford Hotel, Philadelphia, Pa., October 24-25.

American Welding Society—Annual meeting, New York, N. Y., October 24 and Atlantic City, N. J., November 17-22.

RLM Standards Institute—Annual meeting, Brighton Hotel, Atlantic City, N. J., October 28.

National Electrical Manufacturers Association—Annual meeting, Traymore Hotel, Atlantic City, N. J., October 28-November 1.

National Farm Electrification Conference—Sherman Hotel, Chicago, Ill., November 7-8.

National Research Council—Conference on Electrical Insulation, Johns-Hopkins University Baltimore, Md., November 7-9.

National Association of Railroad and Utilities Commissioners—Annual meeting, New Orleans, La., November 12-15.

New Jersey Utilities Association—Annual meeting, Seaview Country Club, Absecon, N. J., November 22-23.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, N. Y. December 2-7.

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

FEDERAL LIGHT & TRACTION CO. has been authorized to merge four New Mexico subsidiaries into one company, to be known as Public Service Co. of New Mexico. Subsidiaries are Albuquerque Gas & Electric Co., New Mexico Power Co., Las Vegas Light & Power Co. and Deming Ice & Electric Co. The new company will assume all their assets and liabilities. (Release No. 6887).

COMMONWEALTH & SOUTHERN CORP. has been authorized to pay a dividend of $3 a share on 1,482,000 preferred shares. (Release No. 6894).

PEOPLES LIGHT & POWER CO. is no longer a holding company and its registration statement has ceased to be in effect. This action was taken at the request of the company, which is now known as the Texas Public Service Co. The company's activities are now confined to the purchase and distribution of natural gas and leasing of oil lands. (Release No. 6890).

GENERAL PUBLIC UTILITIES CORP.'s application filed jointly with Associated Utilities Corp., its wholly owned subsidiary, covering the proposed dissolution of the latter company and related matters has been approved. Associated will file a certificate of dissolution with the Secretary of State for the state of Delaware, accept the surrender for cancellation by General of all of the outstanding stock of Associated, and thereafter, will distribute as promptly as possible to General all of its assets, or proceeds from the sale of such assets. (Release No. 6895).

CAMBRIDGE ELECTRIC LIGHT CO.'s joint application with its parent, New England Gas & Electric Association, under which Cambridge plans to sell $3,338,000 of its 2 percent notes to First National Bank of Boston, has been approved. Proceeds would be used for additions and betterment to Cambridge's properties. The commission also approved purchase by New England from Cambridge of an unspecified number of shares of Cambridge capital stock for about $490,000 and application of the proceeds to reduction of note indebtedness. (Release No. 6889).

AMERICAN GAS & ELECTRIC CO.'s declaration under which it advances to Kentucky & West Virginia Power Co., a subsidiary, $1,500,000 in cash, has been permitted to become effective. The $1,500,000 will be converted into a capital contribution. (Release No. 6886).

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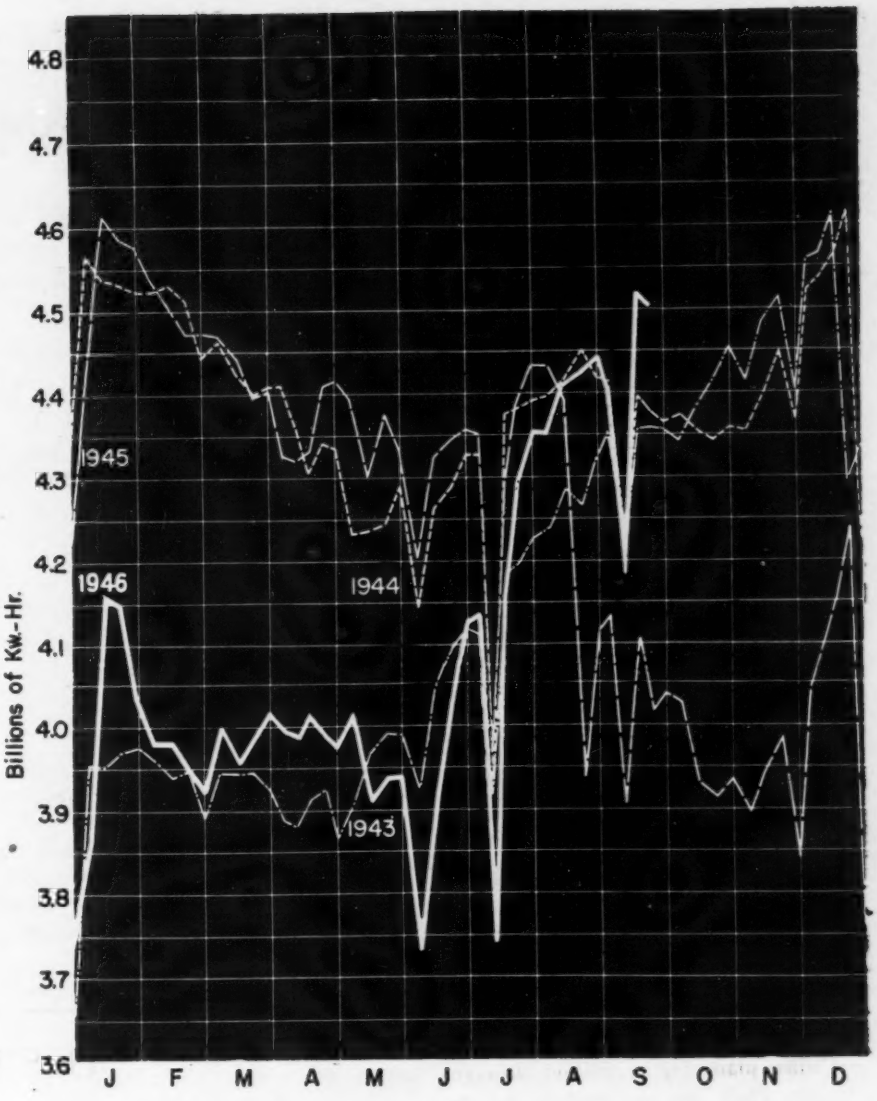
Municipal Buys TVA Lines

Florence, Ala., has purchased 130 miles of rural lines in Lauderdale County from the Tennessee Valley Authority for $230,000. The lines will be operated independently of the municipality's lines, and the city has $520,000 on hand to add 400 miles to its system.



Electric Output Curve Turns Downward

During the week ended September 21, 1946, the electric output curve moved slightly downward, according to figures released by the Edison Electric Institute.

The amount of electrical energy distributed by the light and power industry during the week totaled 4,506,988,000 kw.-hr., compared with 4,521,151,000 kw.-hr. during the preceding week and with 4,018,913,000 kw.-hr. during the corresponding week of 1945, that of September 22. The increase for the country as a whole for the week ended September 21 as compared with last year was 12.1 percent.

All of the major geographical regions of the country, with the exception of the Central Industrial group, showed higher increases for the week ended September 21 as compared with last year than they did for the week ended September 14. The Central Industrial States' increase dipped from 11.8 percent to 11.6 percent. Substantial gains were reported by the Southern States, 18.0 percent, as compared with 12.4 percent the preceding week, and by the Pacific Coast States, 14.6 percent, against 10.9 percent the preceding week.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
Sept. 21	4,507	Sept. 22	4,019	Sept. 23	4,377
Sept. 14	4,521	Sept. 15	4,106	Sept. 16	4,395
Sept. 7	4,184	Sept. 8	3,909	Sept. 9	4,228
Aug. 31	4,404	Sept. 1	4,137	Sept. 2	4,415
Aug. 24	4,444	Aug. 25	4,116	Aug. 26	4,418
Aug. 17	4,422	Aug. 18	3,939	Aug. 19	4,451
Aug. 10	4,412	Aug. 11	4,395	Aug. 12	4,415
Aug. 3	4,351	Aug. 4	4,432	Aug. 5	4,399
July 27	4,352	July 28	4,435	July 29	4,391
July 20	4,293	July 21	4,385	July 22	4,381
July 13	4,156	July 14	4,295	July 15	4,377
July 6	3,741	July 7	3,978	July 8	3,941
June 28	4,133	June 30	4,353	July 1	4,327

Percent Change from Previous Year

	Sept. 21	Sept. 14	Sept. 7
New England	+11.2	+ 7.8	+10.0
Mid-Atlantic	+ 7.0	+ 6.7	+ 6.3
Central Industrial	+11.6	+11.8	+ 9.2
West Central	+ 9.6	+ 9.3	+ 7.1
Southern States	+18.0	+12.4	+ 7.1
Rocky Mountain	+ 3.5	+ 2.3	+ 0.6
Pacific Coast	+14.6	+10.9	+ 4.6
Total United States	+12.1	+10.1	+ 7.0

Uniform Symbols Sought for Refrigeration Industry

In connection with the effort to standardize the abbreviations, graphical and letter symbols used by the air-conditioning and refrigeration industry, the American Standards Association Nomenclature Committee B53, sponsored by the American Society of Refrigerating Engineers, is endeavoring to find out just what is now being used by the industry.

It was felt that the best way to achieve standardization was to study the practises of the industry and adopt the best as standards. Accordingly, 200 refrigeration and air-conditioning firms are being asked to answer these questions:

What graphical symbols do you use in representing refrigeration equipment within the refrigeration cycle?

What letter symbols do you use?

What abbreviations do you use?

Any firm or individual who did not receive a query but is interested is asked to send answers to the questions and any suggestions to D. F. Hayes, secretary, Nomenclature Committee B53, American Standards Association, 70 East 45th St., New York 17, N. Y.

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Utility Operating Revenues Increase 2.5% in July

Electric operating revenues of the larger privately owned electric utilities in the United States in July, 1946, were $265,291,000, as compared to $258,732,000 in July 1945, an increase of 2.5 percent, according to figures released by the Federal Power Commission.

Revenue deductions (including operating expenses, depreciation and taxes) were $204,693,000, or 0.8 percent over those of July, 1945.

Gross income, including other utility operating income, increased 8.4 percent to $660,074,000 and net income in July, 1946, was $44,259,000, an increase of 19.9 percent over the net for July, 1945.

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S. B. Way Dies

Sylvester B. Way, chairman of the board of the Wisconsin Electric Power Co., Milwaukee, was killed on September 20, in an automobile accident near Oconto, Wis. He was 72 years of age. Mr. Way became chairman of Wisconsin Electric Power in 1945 after 25 years as active head of the company and its predecessor, the Milwaukee Electric Railway & Light Co.

Illuminating Engineers Study Technical Aspects of Lighting

I.E.S. Convention at Quebec Includes 27 Papers on 5 Topics on Program—Membership Increases 30 Percent in Year, Totals 5,000—E. C. Crittenden, Bureau of Standards, Given Medal

QUALITY CHARACTERISTICS of lighting, their measurement, calculation, and control, were perhaps the dominant theme at the annual convention of the Illuminating Engineering Society which last week attracted to Quebec, Canada, an attendance of close to a thousand.

In opening the convention, President A. F. Wakefield pointed out that the main product of the Society was its ever expanding pool of knowledge which is accomplished mainly by committee studies and reports. This will be greatly strengthened, according to the plans of President-elect G. K. Hardacre, by an extended research program. Already 15 researches in specific industrial process have been authorized in addition to the revision of several recommended practices.

Reporting on the progress of the Society, L. E. Tayler, general secretary, said that the membership has increased in the year nearly 30 percent to approximately 5,000, and that the attendance at local section and chapter meetings during the year aggregated over 22,000.

At the banquet E. C. Crittenden, associate director of the Bureau of Standards, received the I.E.S. Gold Medal for the "development and international acceptance of a logical and practical system of light units based upon a reproductible primary standard."

Recent developments in lighting equipment displayed by E. D. Tillson, Commonwealth Edison Co., chairman of the Lighting Progress Committee, gave evidence of greater attention to brightness control and accent lighting.

In addition to Mr. Tillson's report, there were 27 technical papers given at five sessions. These papers were grouped under these topics: Residence Lighting, Quality of Lighting, Special Lighting Applications, Interior Lighting, and Sources, Spectrum and Photometry.

Electrical News

MEDALIST—E. C. Crittenden, left, Bureau of Standards, receives the I.E.S. Medal from President A. F. Wakefield at the convention last week of the Society at Quebec

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West Penn Power Plans 80,000-Kw. Mitchell Plant

A new steam station, named for its president, H. L. Mitchell, will be erected by the West Penn Power Co. at a cost of $14,000,000. The 80,000-kw. plant will be located on the southwest bank of the Monongahela River, between New Eagle and Elizabeth, near Courtney, Pa., about 20 miles from Pittsburgh.

Construction will begin next spring with a turbine, a duplicate of the recently installed No. 7 at the utility's Springdale station. Provisions will be made to add three similar units later, giving the station a total capacity of 320,000 kw. When the new unit goes on the line late in 1948, West Penn will have a total capacity of 640,000 kw.

Mitchell station will be close to West Penn's center of distribution, the Charleroi substation, and will tie in through interconnecting lines with the company's system. All West Penn stations are interconnected with those of affiliated companies and neighboring utilities to make a completely integrated system supplying the needs of western Pennsylvania, West Virginia, Maryland, and Ohio.

Tie Line Section Cost $10,300 Per Mile

OVER-ALL COST including materials and labor on a 6.55-mile, 110-kv., tie line section energized recently to provide back-up power and interchange flexibility totaled $67,509, according to the field sheets of the reporting utility. The section included in the tabulation embraces one area, beyond which the line was extended through other territory. Pole heights ranged from 35 to 75 ft. The line ran through rolling country without serious obstacles. Costs were not segregated in the data available between labor and material, but were combined for all items. The circuit was built to share an existing right-of-way, and a wooden cross member attached horizontally to a pair of poles at each structure carries the suspension insulators, the ground wire being carried at the top of one pole, which is somewhat longer than the other.

Installed Cost of 110-Kv. 3-Phase Tie Line Section

Poles	Number	Installed Cost
35 ft.	6	$ 627.27
40	7	822.45
45	54	6,724.27
50	24	3,469.30
55	10	1,729.61
60	50	10,022.40
65	21	4,916.56
70	8	2,169.71
75	1	339.12
Guys	35	1,336.74
Anchors	35	927.88
Horizontal Arms (sp.)	83	4,273.26
Conductors, 4-Strand, No. 0000 Copper, 103,434 ft.		18,961.36
Ground wire, Galvanized, 7-strand, 34,478 ft.		2,680.41
Insulator discs—8 unit, strings 237		7,275.90
Insulator discs—9 unit, strings 38		1,233.03
Total		$67,509.27
Per Mile of Circuit		$10,300

Shop Tested Meters Get Final Use Test

J. L. HALEY, Supt., Electric Meter Dept., Memphis Light Gas & Water Div.

METER CHECK PANEL—Each day's output from Memphis meter shop is installed on this board and has 10 kw.-hr. run through it, under time clock control, as a final check on registration. All meters start check reading 9,990; those not reading like the rest at the end of the run are retested

AFTER BEING TESTED, checked and sealed, but before they go to the storeroom, each day's output of watt-hour meters from the meter shop of Memphis Light Gas & Water Division are installed on a gang test panel where approximately 10 kw.-hr. are passed through them as a final over-all check. Since all registers read 9,990 at the outset of this check, those that do not read alike—and approximately 0,000—at the end of the check are "suspect."

The gang test board on which this check is made consists of six panels containing 73 meter sockets arranged to take any single-phase meter from 5 to 50 amp. Socket meters can be installed directly on the panels; "A" types by means of a plate adapter and jumpers. Insertion of meters in the sockets automatically opens a short-circuiting device in each socket making it unnecessary to short out current clips of unused sockets individually.

Current passed through meters on the board is under the control of a time switch set for the number of hours required to run up about 10 kw.-hr.—approximately 9 hr. for a current of 9 amp. at 120 v. It is not necessary that exactly 10 kw.-hr. be run through the meter since the test is intended only to catch meters which do not read the same as all others at the end of the check period. The exact amount of current put through meters during the check is recorded on four "check meters" (one for each row of meters in accompanying picture). A master reversing switch permits running the whole "batch" of meters backward to bring registration to zero to take care of any minor inaccuracy in the time switch setting. A small toggle switch under each socket permits selection of either a 120 or 240-volt

potential for that particular socket.

The gang test panel is filled with the day's testing production the last thing each afternoon and the time clock started. The next morning when the shop is opened all meters on the panel should read alike and within the accuracy of the time clock setting will be at zero. Those that do not are retested.

It is considered that this check panel paid its $500 cost in the first two months of operation. Out of 2,100 meters tested in that interval it caught 28 "suspect" meters. Had these meters gone undetected it is estimated that the cost of adjusting the customers' complaints and replacing the meters would have totaled at least $500. Present plans call for adding 24 more sockets to the test panel.

• • •

Resistance Measurement by Vacuum Tube Voltmeter

AMONG the various uses of a vacuum tube voltmeter is the measurement of resistance. How the instrument can be employed for that purpose is outlined here by Slyvania Electric Products Inc., Emporium, Pa. Many of the later types of vacuum tube voltmeters have additional scales for reading resistance.

A fundamental circuit for resistance measurement is shown in diagram (1). The source of voltage should be high enough to give nearly full scale deflection on the meter for the higher value resistor. The voltage (E_s) across the known resistor (R_s) is read and then the voltage (E_x) across the unknown. The resistance will be

$$R_x = R_s \times \frac{E_x}{E_s}$$

Values of R_s should be selected between 1/5 and 5 times the unknown resistor so as to read on the most accurate position of the scale.

This equation is good for any vacuum tube voltmeter which reads direct current, providing the resistance of the voltmeter is high with respect to the values of both resistors.

When an ohmmeter is designed into a vacuum tube voltmeter other methods can be used so that several ranges, all direct reading, can be used. Since the best method will be different for the various voltmeter circuits, only the above general method can be covered here.

A method to use when you have a 10-megohm resistance in the voltmeter and desire to measure a resistance between 1 and 100 megohms may be of sufficient interest to describe here. The resistance of the meter should first be found if it has not been given by the manufacturer. An easy way to do this is shown in diagram (2).

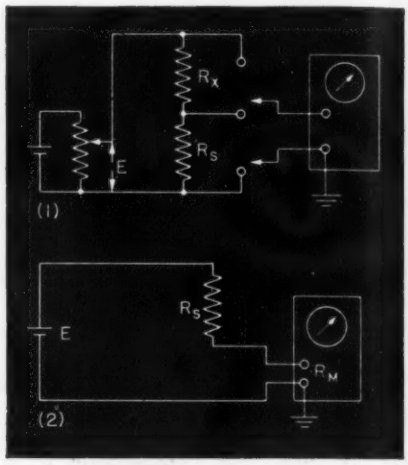
R_s is any known high value resistance in this range. E is a known voltage (measured with the vacuum tube voltmeter), E_1 is the voltage reading on the meter connected as shown. Resistor R_s can be considered a multiplier to the meter which enables the meter resistance (R_m) to be found from the equation

$$R_M = \frac{E_1 R_s}{E - E_1}$$

Now R_x can be substituted for R_s and from E_2 (the meter reading when the unknown resistor is in series)

$$R_x = \frac{R_M (E - E_2)}{E_2}$$

Some commercial vacuum tube voltmeters read only a.c. voltages but this need not prevent the measurement of resistance by the above methods. Referring to both diagrams, just use a low-voltage winding on a power transformer in place of the battery. The value obtained will really be the impedance at the power line frequency but for everything except transformers, iron core chokes and probably speaker coils the difference will be negligible. The d.c. resistance of these components cannot be measured without some kind of d.c. meter.



MEASUREMENT of resistance. (1) A fundamental circuit when using a vacuum tube voltmeter. (2) Circuit employed when determining resistance of a meter

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Joint Rural Line Service in Connecticut*

G. J. WILLIAMS
Division Manager
Connecticut Light and Power Co.
Willimantic, Conn.

RATHER than having separate lines on opposite sides of the highway, joint pole lines are now constructed almost exclusively in Connecticut. The design lends itself to both telephone and power system occupancy. Companies entering an area first now give consideration to future joint occupancy in their designs, with a minimum of change. Pole spacings in joint construction are laid out on an average of 300-ft. spans with 250-ft. road crossings on rural highways and with a reduction to 200 ft. on state highways. Line pole heights are generally 35 ft., using shorter poles for guy stubs and service poles. Class 5 creosoted yellow pine poles are generally used. In single-phase work crossarms are standard 4-pin creosoted fir, but with only the two outside holes equipped with pins, which gives adequate separation of line conductors on longer spans. Single arms are used in practically all cases unless the line angle is especially severe. Steel pins are used rather than wood on angle construction. Guying tables have

* From a paper before the seventh New England Rural Electrification Institute, Amherst, Mass., April 17, 1946.

been worked out with the telephone companies to cover the safety factors involved in long span work.

The Connecticut Light & Power Co. has used a copper-bronze composite conductor. It consists of a high-strength bronze wire combined with two copper wires. The size of conductor used is selected to permit the equivalent of No. 6 or No. 4 copper in conductivity, the choice depending on the contemplated loads. In most cases 4.8-kv. delta construction is used. The question of primary or secondary conductors as a service into the individual installation is determined by the location and layout of the farm buildings, carrying the primary into the farm load center where distances so dictate. On the basis of 3 to 3½ customers per mile, practically no secondary runs are made on line poles, since each customer usually requires a transformer.

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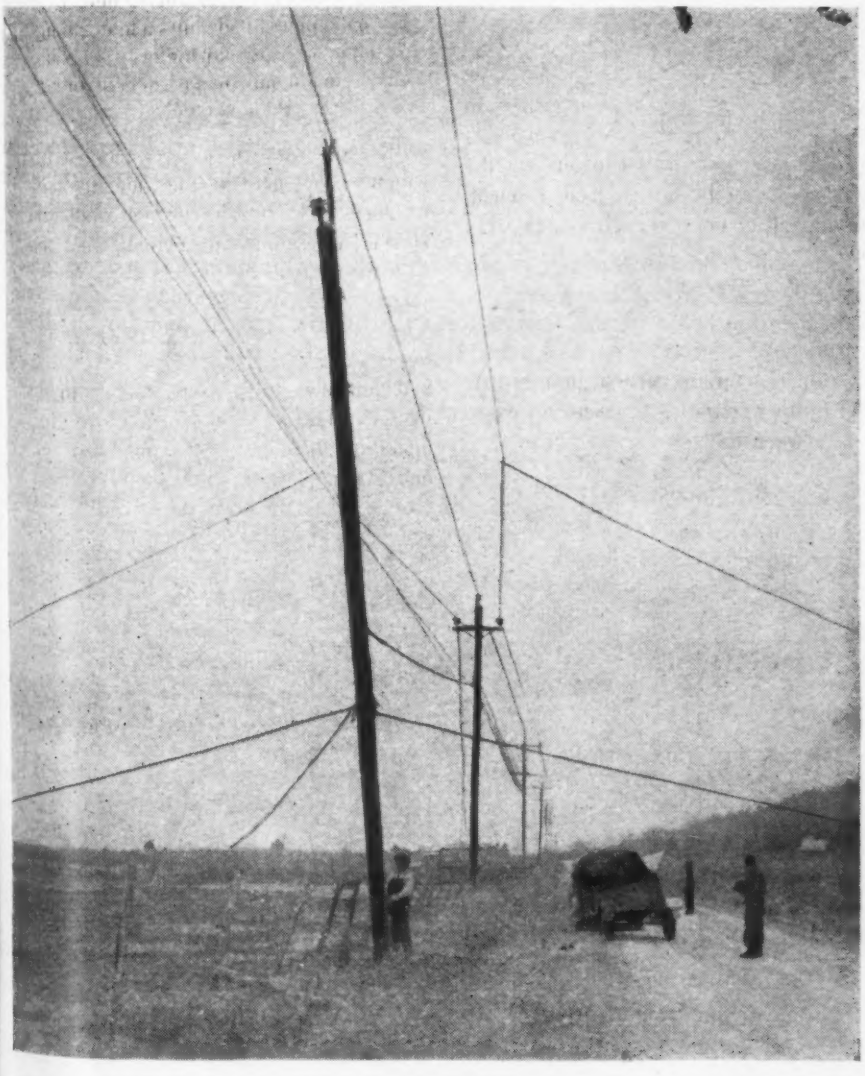
How Live-Line Tools Are Used by TVA

W. L. WAGES, Chief, Transmission System Maintenance Staff, Tennessee Valley Authority, Chattanooga, Tenn.

Since the beginning of the Tennessee Valley Authority's operation of power lines, the Authority has done live-line work where necessary in order to avoid interruptions to important loads. This has been done not only in connection with normal repairs and replacements but also in connection with the construction and conversion of lines for operation at higher voltages, changing lines from pin-type to suspension-type construction, and respacing poles to increase span lengths. Although it has not been possible or desirable to do all this work with the lines energized, a considerable number of interruptions to customers have been avoided by performing the work with the lines energized and using live-line tools.

POLE being installed in a span on an energized 44-kv. line with pin type insulators. A ridge-pin lift pole is clamped to the pole to provide clearance with the center conductor prior to fastening to the ridge-pin insulator. Side conductors have been spread by roller link sticks and rope lines. Trailer is used for storage and transportation of tools



The Authority has twenty-three maintenance crews trained and equipped to do work on wood-pole and steel-tower lines of voltages ranging from 22 kv. to 154 kv. with conductors up to 700,000 cir. mils. The equipment for each crew includes a specially built trailer with racks for the tools and a small electric heater, which is connected to a convenience outlet to avoid condensation when the trailer is stored, since it is used not only to carry the tools to and from the job but also as a storage place in the crew headquarters. All the tools are purchased from the regular manufacturers of this equipment, but most of the heads or working ends of the sticks have been developed from ideas originated by the men in the field.

Applications

Live-line tools have been used for replacing poles, crossarms, and insulators on practically all types of wood-pole lines. On steel-tower lines, the work done with these tools has been limited primarily to the replacement of insulators of both the suspension and strain types.

The accompanying illustration shows the installation of a pole near the center of a span on a 44-kv. line with pin type insulators.

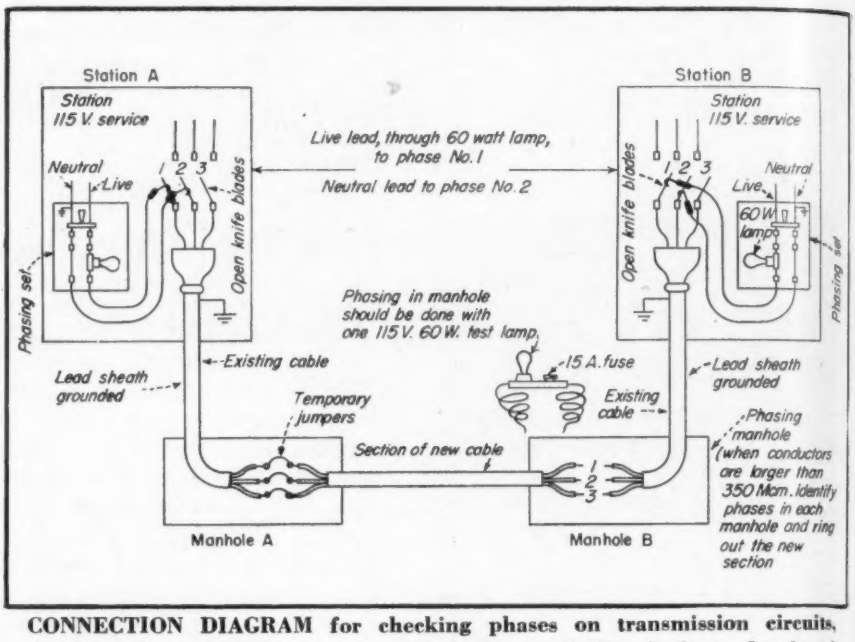
Sequence of operations for the installation of a pole will be outlined in an ensuing issue.

Identifying Phases in Transmission Circuits

IN AN eastern power system an effective method of checking phases has been developed for use in both underground and overhead transmission circuits in connection with jointing in new sections of line. The procedure in the typical case of installing a new section of cable between two manholes connected with two existing substations by cables as illustrated is as follows:

When the crews are assembled at manholes A and B, the disconnecting switches having been opened at each substation (A and B) to kill the cable running to each manhole, the dispatcher is called to order each substation operator to supply low-tension (115-volt) phasing current for the test. Each substation is equipped with a simple phasing set consisting of a 2-pole knife switch, 115-volt station service supply, a 60-watt lamp in series with the live load terminal, and leads long enough to reach any set of cable terminals in the place. At all potheads in all stations the phases of outgoing circuits are permanently identified.

The splicers need to learn the phasing in each manhole in order to properly install new cable. Splicers at each end of the new cable agree at which manhole phasing will be completed (e.g. manhole B). Rubber gloves are worn while phasing. The crew in manhole A now makes temporary connections with jumpers between suitable conductors of the existing and new cable. At each substation the phasing lead from the lamp side is connected to phase 1, the phasing lead from the ground side being connected to phase 2. Nothing is connected to phase 3. Then in manhole B, using a 60-watt bulb in series with a 15-amp. fuse, the splicers make connection between each conductor and ground. When the test lamp in the manhole lights dimly, the splicer knows that the conductor is phase 1. After finding phase 1, the splicer marks it and then tests between phase 1 and each of the other two phases. When his lamp again lights dimly he knows that he is connected between phase 1 and phase 2. This identifies phase 2. Phase 3 should show no light when connected through the lamp to other phases or ground.



CONNECTION DIAGRAM for checking phases on transmission circuits, distribution supply lines and network feeders, including both overhead and underground facilities

The above test is then repeated for the other cable.

If the phases as identified will not make a satisfactory arrangement in the splice, the temporary jumpers in manhole A are shifted, and the test repeated in manhole B until a suitable combination is found. At the end of the phasing, the manhole crew gives the station operator a disconnecting signal by short-circuiting phases 1 and 2 of each end of the conductors, to give a bright light at the station in the phasing set there located. The substation operator then removes the phasing equipment from the line or circuit.

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Industrial Plant Combined Power and Light . . . I*

L. C. PETERMAN, Electrical Engineer, Ford, Bacon & Davis Inc., New York, N. Y.

IN MODERN industrial plants alternating current for lighting and power is usually distributed by one of the following methods.

(a) 120/208-volt substation(s) and feeders with lighting supplied at 120 or 208 volts single-phase and power supplied at 208 volts, 3-phase.

(b) Separate substations and feeders for lighting at 120/208 volts and for power at 460 volts.

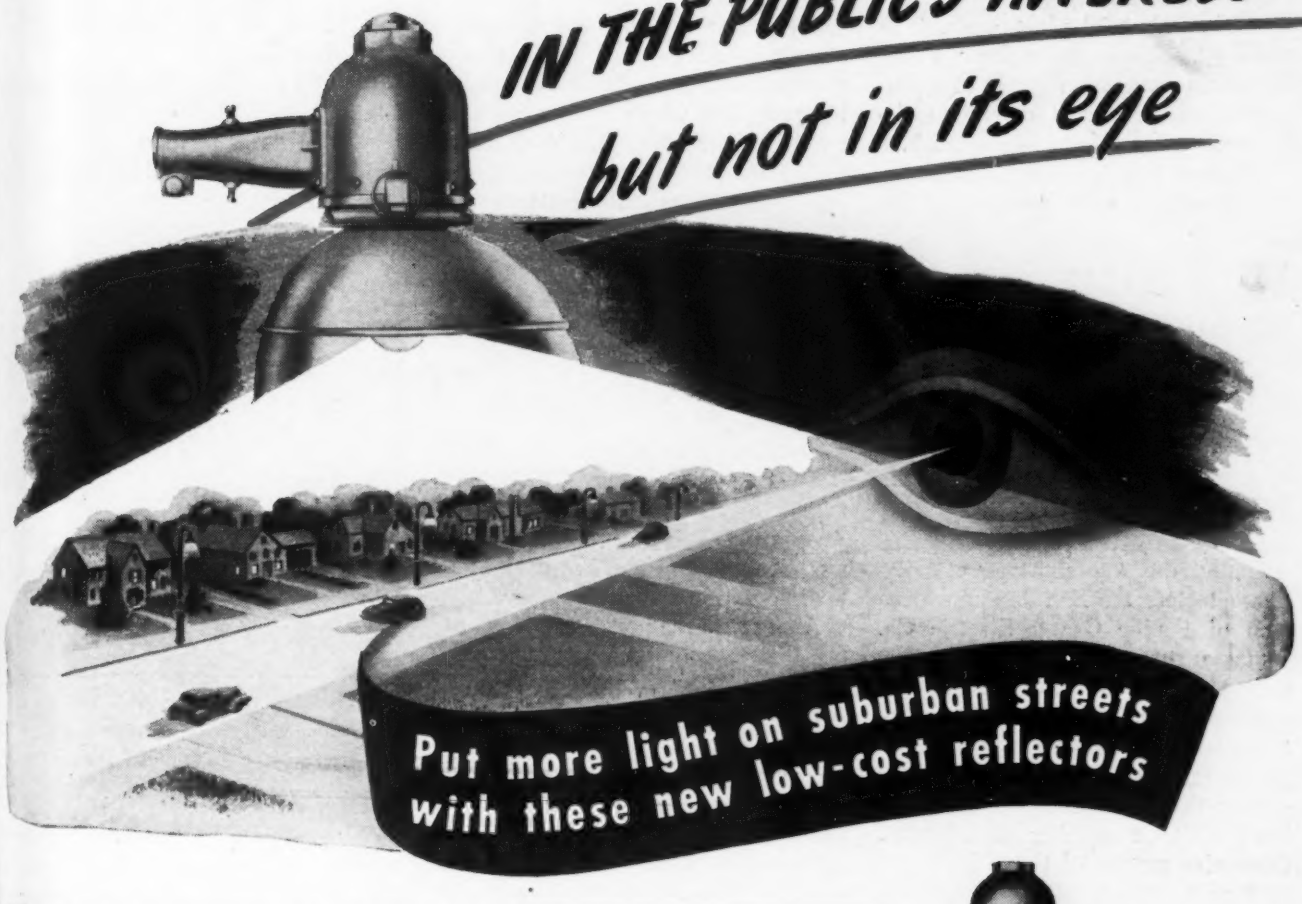
(c) Combined power and light substations operating at 460 volts, 3-phase, with air-cooled transformers either single-phase or 3-phase distributed around the plant for lighting, and with power supplied directly at 460 volts.

(d) Combined power and light substations operating at 265/460 volts, 3-phase, 4-wire with lighting connected between phase wires and neutral and power straight 3-phase, 3-wire at 460 volts.

With the great variations encoun-

* Beginning a series of three articles.

IN THE PUBLIC'S INTEREST—but not in its eye



HERE are the successors to the radial-wave reflector—two new G-E suburban reflectors that now bring scientific light distribution to the lighting of residential streets. Light formerly dissipated in non-useful directions is utilized to better advantage. Direct glare is greatly reduced. Uniformity of illumination on the road is much improved, yet installation and maintenance are easy.

Two types—open and enclosed—using series lamps of 1000- or 2500-lumen rating are available with adapters to fit practically any fixture that takes the standard-dome radial-wave reflector. They may be installed either as unit-for-unit replacements to provide better light distribution, or in accordance with I.E.S. Recommended Practice to obtain specified illumination levels at low cost.

These G-E suburban reflectors offer utilities an inexpensive way to improve suburban lighting in their communities and to keep that lighting at high efficiency for years of low-cost service. Why not check the features listed here, then ask your local G-E representative how these reflectors can fit into your suburban streetlighting plans? *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

SCIENTIFIC LIGHT CONTROL

A highly efficient light distribution pattern effectively utilizes much of the light ordinarily wasted in producing objectionable glare and illumination of house fronts.

HIGHER LIGHTING LEVELS

When equipped with the new G-E 2500-lumen lamp of 5⅜-inch light-center length and spaced as recommended, I.E.S. Standards for suburban lighting can be readily met.

USE TWO WAYS

1) *In existing installations* as unit-for-unit replacements for radial-wave reflectors.

2) *In new installations* to provide higher lighting efficiency and more uniform illumination.

LOW MAINTENANCE COST

Alzak-processed aluminum reflectors retain high efficiency for years under all weather conditions, and are easily cleaned when necessary. Enclosed type has refractor spun-sealed to keep out dirt and to practically eliminate breakage.

(a) Form 79 CR luminaire with enclosed suburban reflector. Simple latches and safety chain facilitate relamping.

(b) Form 45 L luminaire with open suburban reflector. Either one or two shields may be easily attached if needed.

Are you tieing in with the NEMA plan to give America better street lighting?

Good Street Lighting
BUILDS GOOD WILL

STREET LIGHTS *for better seeing*

GENERAL ELECTRIC

452-39-3010

tered in industrial plant work, it is usually necessary to evaluate all of the above methods in layout of a proposed installation to determine the economies and advantages of each.

Method (a) is quite satisfactory and generally most economical for small compact plants where feeders are not over 100-125 ft. in length and motors are small. It is significant, however, that where a plant has scattered loads, a 460- or 575-volt distribution with a 3-phase transformer at each load center usually costs no more and losses are no higher than for method (a).

Method (b) is seldom as economical in first cost, operating cost or space requirements as methods (c) or (d) which will be discussed in two subsequent articles.

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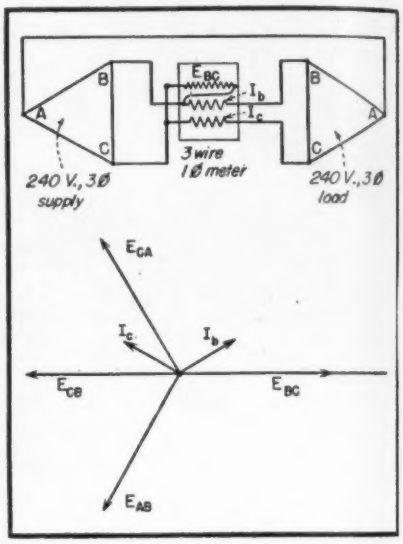
Single-Phase Meters Used For Three-Phase Balanced Loads

C. E. MYERS
Pacific Gas & Electric Co.
Fresno, Calif.

DURING the war shortage of polyphase meters the San Joaquin Division of Pacific Gas & Electric Co. found it expedient to meter some three-phase loads with three-wire, single-phase, house type watthour meters, and with the present outlook the practice may have to be revived. Back during the war the division had on hand quite a number of 25-amp., three-wire meters of the older types such as Sangamo HC, Westinghouse OA, and G. E. 1-16. Vector analysis as illustrated indicated that by using both current coils in legs of a *balanced* three-phase circuit such single-phase meters would correctly measure kw.-hr. by using a multiplier of two. Accordingly this method was used for measuring balanced loads until regular meters were available.

Along with the present meter shortage that may revive this practice the division is faced with a shortage of current transformers and 5-amp., polyphase meters for 480-volt service. To conserve on both, the division is deviating from its standard of not over 50 hp. on a 50-amp. meter by allowing as high as 75 hp. to be metered on the newer overload type of 50-amp., 480-volt, self-contained meters. This will save transformers and meters for the larger jobs.



VECTOR ANALYSIS shows that three-wire, single-phase meter will correctly measure ½ (E_{BC} I_b cos 30) + ½ (E_{CB} I_c cos 30) = 0.866 EI, half the three-phase load

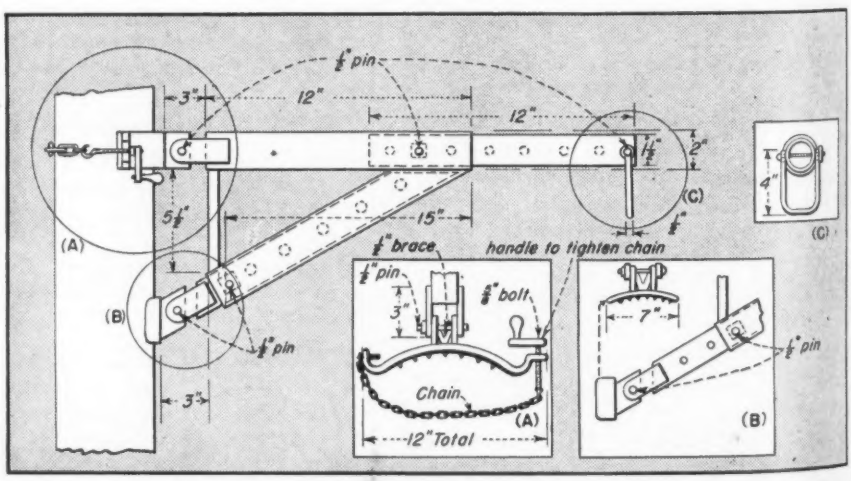
• • •

Portable Crane Aids Transformer Handling

A PORTABLE DEVICE of pipe-frame construction serves as a crane for use in raising and lowering transformers on poles without crossarms. It is clamped to the pole and a block and tackle attached to the ring at the far end of the extended arm. This keeps the transformer away from the pole as it is being raised or lowered. The homemade device is a development of Earl Bing while a serviceman for the Arkansas Power and Light Co. at Eudora but now local manager at Portland, Ark.

The all-welded frame at the bottom has an arc member of ½-in. stock about 1½ in. wide, which is a support on the pole. Top support is a becket form consisting of a section of chain and of a brace made from ½-in. stock about 1½ in. wide. One end of the brace has a notch so that the chain can be set in, locks in and cannot slip. Opposite end of the brace has a screw bolt to which is attached the other end of the chain. The screw bolt has a handle on the bolt for easier tightening of the chain against the pole.

Top member of the crane is a 2-in. pipe with a 1½-in. pipe extension which can be locked in position by a bolt. The telescopic action permits the proper clearance between pole and the different sizes of transformers. Support member likewise has telescopic action.



PIPE-FRAME CRANE made with adjustable extension for transformer clearance

Helps minds at work!

It's the construction of G-E ballasts that helps keep fluorescent fixtures quiet.

The distracting effects of ballast hum won't plague the employees of your customers—nor build up your complaint file—if your fixtures are equipped with G-E ballasts. Noise is *built out* of the G-E ballasts at the same time that long life is *built in.*

Constructed to exacting standards, the G-E ballast typifies G-E engineering in the various phases of fluorescent lighting. The finest low-loss core steel is uniformly rolled, stamped, and stacked as part of the *controlled quality* construction. Machine winding produces rectangular solid coils and eliminates "springy" layers, while a special sealing compound fills every void and seals the components to one another and to the ballast case.

The clamping frame is designed to prevent shifting of parts and resulting noise. Wiring is made easy by the angle slot construction which lets leads out at either ends or bottom. You can thus use one case style for many different mountings.

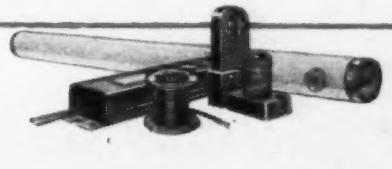
The G-E trade mark on fluorescent lighting equipment signifies the best that engineering skill and quality manufacture can produce. And remember, there is a G-E component for *every* lighting requirement. The next time you have a lighting problem, call in your local G-E representative. Our complete facilities are at your service.

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

General Electric ballasts help keep fixture users satisfied—they mean added profits for you

1. Low noise level—for satisfied users
2. Long life—for low maintenance cost
3. Characteristics matched with lamp—for rated lamp life and light output

BALLASTS LAMPS STARTERS
LAMPHOLDERS CABLE
for DEPENDABILITY in fluorescent lighting



GENERAL ELECTRIC

How a Liquid Slip Regulator Functions

F. R. BURT, Industry Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

A FLYWHEEL, in order to give up energy, must slow down in speed, and the rate at which it gives up energy is dependent on the rate at which it slows down. A wound-rotor induction motor will slow down if resistance is inserted in the secondary circuit, and the speed at which it will run, at a given load, depends on the amount of resistance.

Therefore, given a generator, a flywheel and a wound-rotor motor on the same shaft, a part of the load can be shifted from the motor to the flywheel by inserting resistance in the motor secondary, and the current input to and torque supplied by the motor can be limited to definite values by inserting resistance at the proper rate. This can be accomplished by using an automatic liquid slip regulator.

This regulating device consists essentially of three pots filled with a solution of soda ash. A stationary electrode is mounted in the bottom of each pot and one phase of the motor secondary is connected to each electrode. A moving electrode is suspended in each pot from a common crossbar, which forms the star connection. The crossbar is in turn suspended from a rotating arm mounted on the shaft of an a.c. wound-rotor torque motor. The torque motor primary is energized from the secondary of a current transformer whose primary is in series with the main motor primary circuit. Therefore, the torque exerted by the torque motor is dependent on the load on the main motor. The torque tends to drive the moving electrodes up and thus increase the resistance in the main motor secondary circuit. However the rotating arm is counterweighted to such an extent that at the desired load limit on the main motor it is just in balance.

Any load above the predetermined setting will cause the electrodes to move apart vertically, thus increasing the resistance, which will drop the speed of the flywheel and force it to give up energy. Any load below the predetermined setting will cause the electrodes to move together, thus decreasing the resistance, which will increase the speed of the flywheel and store up energy. When the speed has reached no-load value the electrodes will have moved together and the load on the main motor will have dropped to friction load.

Any load below the regulator setting is carried entirely by the motor. Any momentary load in excess of the regulator setting is carried by the flywheel. It is necessary, of course, that the regulator setting be equal to or higher than the average load, and that the flywheel be of sufficient size so that the energy taken from it during any peak or series of peaks will not cause its speed to drop below a reasonable value.

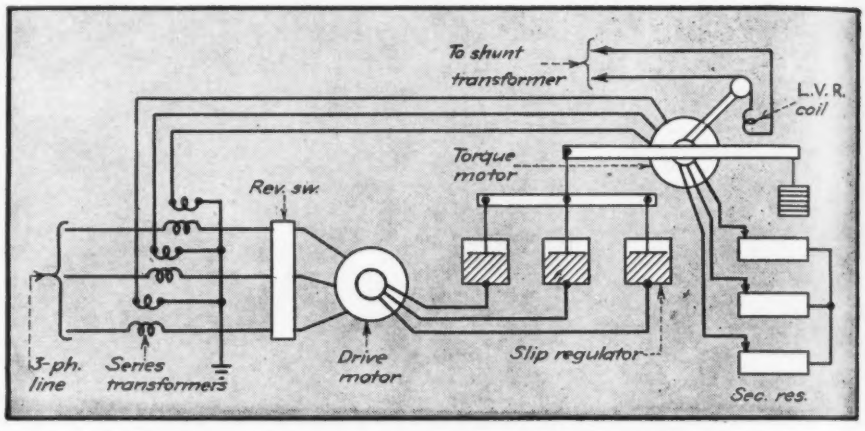


FIG. 1—Schematic connections for automatic liquid slip regulator

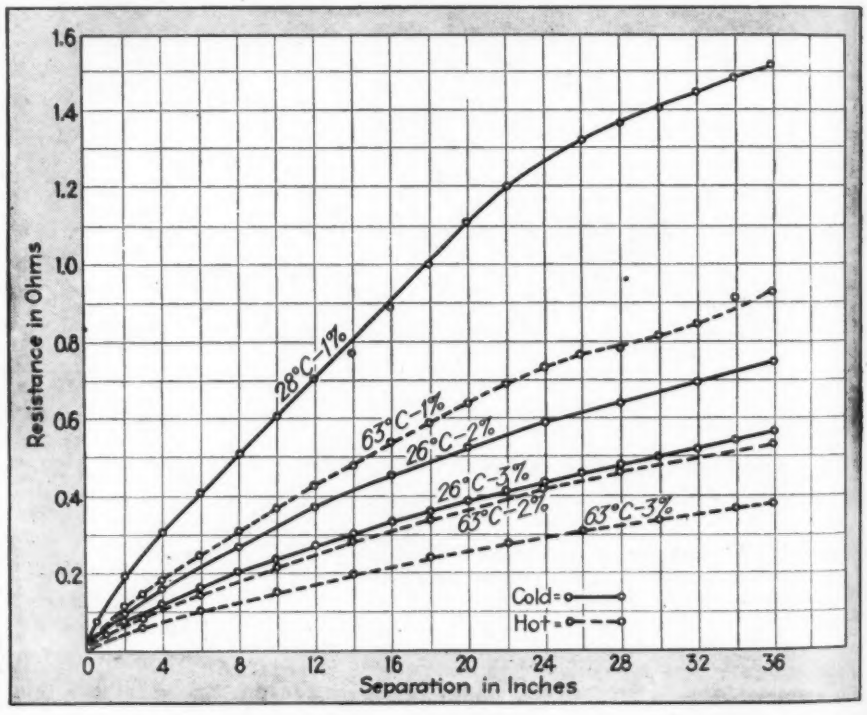


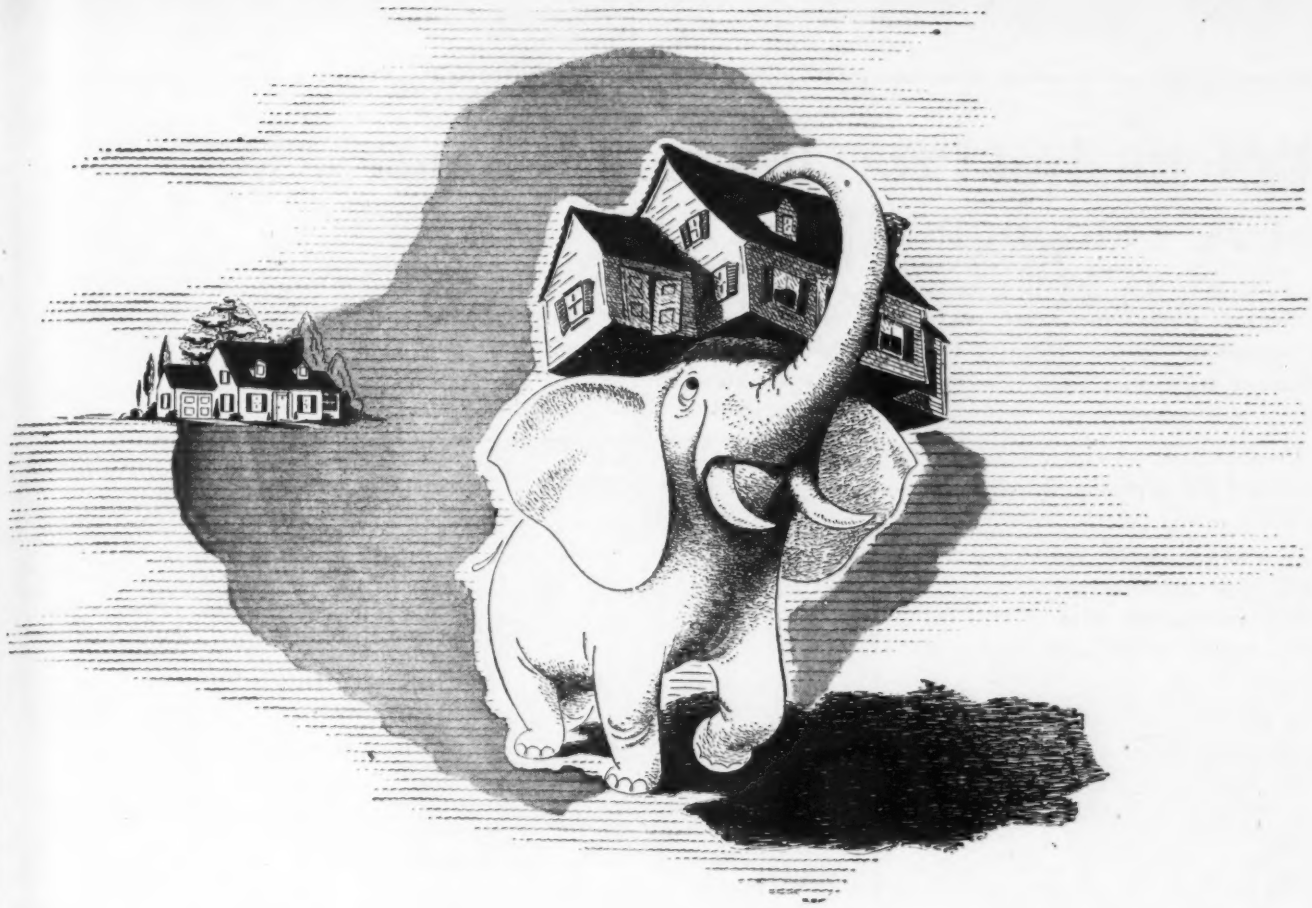
FIG. 2—Typical hot and cold resistance curves for three-phase slip regulator using 1, 2 and 3 percent soda ash solutions; each stationary and movable electrode having adjacent flat faces and 490-sq.in. gross face area

Horsepower-hours (hp.-hr.) absorbed by the regulator are:

$$\text{hp.-hr.} = \left(\frac{\text{hp.}}{2}\times\frac{b}{a}\times\frac{c}{60}\times\frac{d}{1}\right)+\left(\frac{\text{hp.}}{1}\times\frac{e}{a}\times\frac{f}{100}\times\frac{g}{60}\right)$$

where

- hp. = horsepower of motor
- a = full load torque
- b = starting torque
- c = starting time in minutes
- d = number of starts per hour
- e = regulating torque or torque when running at reduced speed
- f = percent speed reduction
- g = number of minutes per hour during which speed regulation is required



white colonial, 1946 white elephant, 1956

don't let today's dream home become tomorrow's disappointment . . .

because of inadequate wiring

The fate of new homes today is not only vitally important to the owner, but to the many businesses that have a stake in building and equipping them.

Nobody has a greater stake than the electrical industry, for it is upon customer acceptance of electrical service and its many advantages that power loads are built and maintained. Realizing this, America's power suppliers have played a leading part in the promotion of adequate wiring — the key to increased use of electric power and more satisfactory performance of electric equipment and appliances.

As a result of these campaigns, many homes that might have been *built obsolete* because of inadequate electrical planning are now actually being *built for tomorrow* . . . ready for the appliances and conveniences to come.

To help power suppliers in this essential work, G.E. has prepared a number of hard-hitting booklets for home builders. They include: (1) *Electrical Modernization Guide* — a factual, useful guide to practical wiring; (2) *Farm Wiring Guide* — planning every step of farm electrification in complete detail; (3) *Home Wiring Chart* — a fascinating way for homeowners to determine the electrical needs of their own homes; and (4) *Home?* — the brand new, 32-page book printed in beautiful colors, a *must* for forward-looking homeowners.

Sample copies of these, and other helpful aids are available to you now. Check the ones you need, on the coupon, and mail it today. They can do wonders for the promotion of adequate wiring in your community.

Section AW11-99
Appliance and Merchandise Department
General Electric Company
Bridgeport 2, Connecticut

Please send sample copies of the materials checked

☐ Electrical Modernization Guide ☐ Home Wiring Chart
☐ Farm Wiring Guide ☐ Home?

Name_____ Title_____

Company_____

Address_____

City_____ State_____

GENERAL ELECTRIC

A Method to Provide Line Clearance At A Telephone Pole

Pole top clearance attachment has been developed as an extension for a telephone pole. Details outlined here are from a design in use by Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.

CLEARANCE ATTACHMENT is made of creosoted yellow pine or Douglas fir, is fastened to the pole by reinforcement bands, and is equipped with a 3-point rack for service conductors.

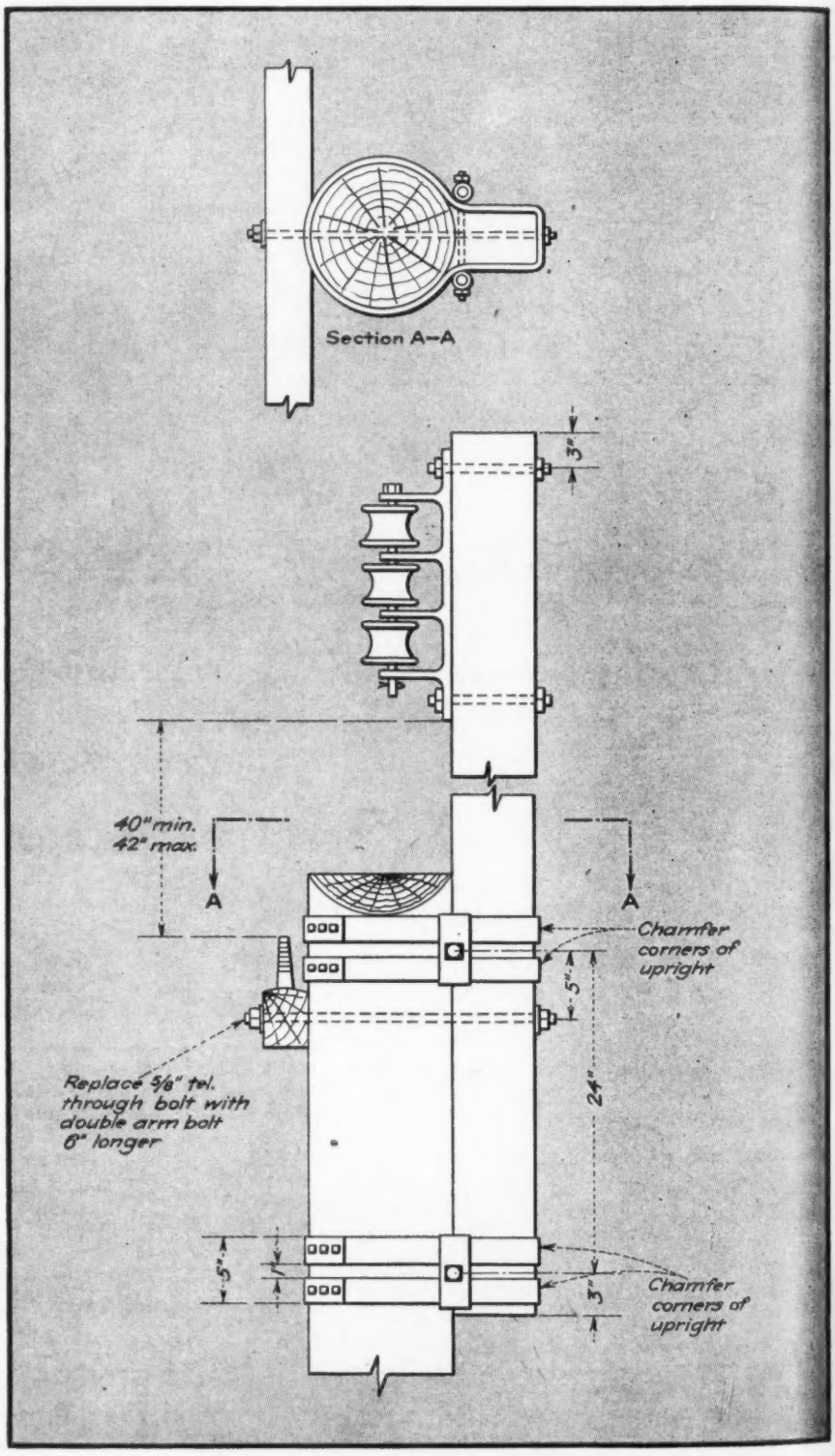
This construction is to be used only where remaining life in telephone pole is ten years or greater.

MATERIAL LIST

Quantity	Description
1	Plank, 4 in. x 6 in. x 8 ft.
4	Reinforcing band
4	Reinforcing pipe washer
2	Through-bolt, 5/8 in.
1	Double-arm bolt, 5/8 in.
4	Lag screw, 1/2 x 4 1/2 in.
1	3-point rack
2	Through-bolt, 5/8 x 8 in.

NOTE: A clearance of 24 in. shall be obtained between the lowest wire of the service loop and the outermost wires of the top telephone crossarm.

A minimum clearance of 1 in. shall be obtained between the telephone wires and any part of fixture.



—with special emphasis on Engineered Lighting

The latest trends in engineering and design are incorporated into Spero products, assuring modern, up-to-date equipment. Spero fluorescent luminaires have always been "one step ahead". The two commercial fixtures illustrated typify the attractive design and correct engineering of all Spero products. Fluorescent fixtures for industrial and residential applications are also available.

You can depend on Spero to furnish products of quality standards that build customer satisfaction and good will. No need to take chances on uncertain, "or equivalent" specifications. Spero products are tested, approved, and meet U. L. requirements.

●

Spero lighting fixtures are designed for quick and easy installation and maintenance. Lamps, tubes and other parts requiring cleaning or changing are easily accessible and removable.

●

Spero production schedules are fast approaching normal, and delivery of most items is being made promptly from stock or current production. If you are not familiar with all 5 lines of Spero products, write today for Bulletin No. 10.

●

Since its founding, 30 years ago, Spero has held strictly to its announced policy of *"Distribution only through legitimate electrical wholesalers"*. Besides protecting jobbers handling Spero lines, this policy makes it possible at all times for contractors and dealers to obtain Spero Products through their regular channels.

SPERO LVR
"Masterpiece of Fluorescent Engineering". Four 40 watt tubes, shielded by evenly spaced louvres, hinged for easy maintenance. Translucent plastic side pieces. Individual reflector for each tube.
Available with "INSTA-LITE" providing instantaneous starting and eliminating starters.
SPERO CVG
Glass-shielded luminaires of smart appearance and high efficiency. Simplified design does not sacrifice quality. Designed for effective use without glass, where desired.
Available with "INSTA-LITE" providing instantaneous starting and eliminating starters.

THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

How to Determine Current Capacity For Cables and Buses In "Still" Air

J. P. C. McMATH Northern Electric Co., Ltd., Montreal, P. Q., Canada

A METHOD is outlined to calculate the current carrying capacity of bare or insulated cables or buses in long horizontal cylindrical form installed in "still" air and at atmospheric pressure. Data available in table form covers common standard sizes and installation conditions fairly well. However, when special sizes or conditions are involved, or when greater accuracy is required, calculations become necessary.

The following formulas, applicable to conductors installed in "still" air, are well known but being rather cumbersome their use consumes considerable time, and for that reason they have probably not been as widely used as in the writer's opinion they deserve.

BARE CONDUCTORS

Formulas as applied to bare conductors

Loss in a conductor is:

$$I^2R = W_c + W_r \qquad (1)$$

where

I = current in amperes

R = effective resistance per foot at operating temperature

W_r = watts loss per foot length due to radiation

$$= 1387\,e\,d\left[\left(\frac{T_o}{1000}\right)^4 - \left(\frac{T_g}{1000}\right)^4\right] \qquad (2)$$

W_c = watts loss per foot length due to free convection

W_c = either

$$\frac{7.60 \times 10^{-6} \times \pi \times 12\ T_a^{0.754} \cdot \Delta t}{\log_{10}\left[\frac{0.0031\ T_a^{0.947}}{d^{0.81} \cdot \Delta t^{0.27}} + 1\right]} \qquad (3)$$

from formula given by Schurig and Frickl[a]

or

$$\frac{7.60 \times 10^{-6} \times \pi \times 12\ T_a^{0.754} \cdot \Delta t}{\log_{10}\left[\frac{0.00438\ T_a^{0.877}}{d^{0.75} \cdot \Delta t^{0.25}} + 1\right]} \qquad (4)$$

from formula given by Enos[c]

in which

e = emissivity of conductor surface

d = diameter of conductor in inches

T_o = conductor temperature, degrees Kelvin

T_g = ambient temperature, degrees Kelvin

T_a = average of ambient and conductor temperatures

$$= \frac{T_o + T_g}{2}, \text{ degrees Kelvin}$$

Δt = temperature rise = $T_o + T_g$

To determine I from equation (1) by means of equation (2) and (3) or (4) is obviously straightforward, most of the labor of calculation, however, occurring in the solution of equation (3) or (4).

OTHER THAN BARE CONDUCTORS

Formulas as applied to conductors other than bare are the same as above but with the following additions. When applied to wires or cables having insulating coverings (e.g., weatherproof wire), d is taken as the diameter over the outer covering and T_o as the surface temperature of the outer covering. The actual copper temperature T_c is therefore greater than T_o by the temperature drop through the insulation, which is given by

$$T_c - T_o = I^2\,R \cdot R_{th} \qquad (5)$$

where

R_{th} = thermal resistance of conductor covering which is given for single conductor cables by

$$R_{th} = 0.00522\ \rho \log_e \frac{d}{d_c} \qquad (6)[b]$$

and for multi-conductor cables by

$$R_{th} = \frac{0.00522\ \rho\ G_1}{N} \qquad (7)[b]$$

where

ρ = thermal resistivity of insulation in watt-cm. units

d_c = diameter of conductor (bare) in inches

N = number of conductors in cable

G_1 = Geometric Factor, all conductors against sheath or assumed isothermal outer surface.[b]

CALCULATIONS

In general, therefore, calculation of the current carrying capacity involves assuming a value for I, calculating the resulting values for T_o from equation (5), then calculating W_c and W_r from equation (3) or (4), and (2). If the values for W_c and W_r so obtained, and the assumed value of I, do not satisfy equation (1), a new value of I is assumed and the process repeated until values are obtained which satisfy equation (1).

Owing to the cumbersome nature of equation (3) and (4) in particular, the above process of "cut and try" normally consumes considerable time and labor. Nomograms[d] have been designed to solve equation (3) for the range of the variables normally encountered in current carrying capacity problems, and thereby greatly facilitate the solution of such problems by the above method. These nomograms may be used also to solve equation (4) with sufficient accuracy, as indicated in the accompanying tabulation, which provides a comparison of results from equation (3), (4), and the nomograms, for four problems selected at random.

CONDITIONS					W_c		
					Calculated from		
T_o	T_g	d	T_a	Δt	Eq. (3)	Eq. (4)	From nomograms
100	80	0.5	363	20	2.35	2.26	2.28
100	40	1.5	343	60	18.2	18.9	19.1
50	20	0.9	308	30	5.54	5.57	5.60
120	30	0.7	348	90	17.9	18.0	18.2

(a) Schurig, O. R. and Frick, C. W.: "Heating and Current Carrying Capacity of Bare Conductors for Outdoor Service." *General Electric Review*, March, 1930.

(b) Simmons, D. M.: "Calculation of the Electrical Problems of Underground Cables." *Electrical Journal*, May to November, 1932.

(c) Enos, H. A., "Current Carrying Capacity of Overhead Conductors." ELECTRICAL WORLD, May 15, 1943.

(d) McMath, J. P. C.: "Nomographic Solution for Heat Dissipated by Free Convection," ELECTRICAL WORLD, September 14, 1946.

APPLY THIS ANSWER

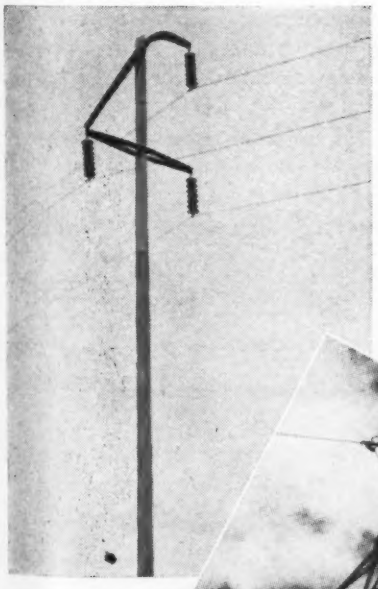
To Your Questions About Suspension Insulators

Most questions about suspension insulators can be answered by one fact--what does their record show? This simple test can be applied to almost any claim a manufacturer may make. Years, and more years, of trouble-free performance is the one best proof of fundamentally sound design.

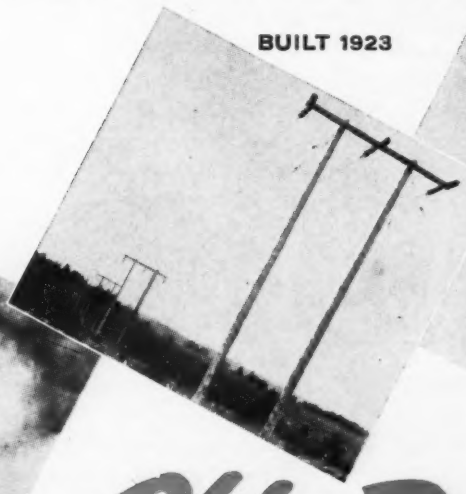
Here are four of a large number of O-B insulated lines that fall into the twenty-to-thirty-year bracket of outstanding service records. Owners of each line have come back to O-B time and again for more suspension insulators used in later construction. The reason is obvious!

You can build with equal assurance of fine insulator performance simply by writing "O-B" into your specifications.

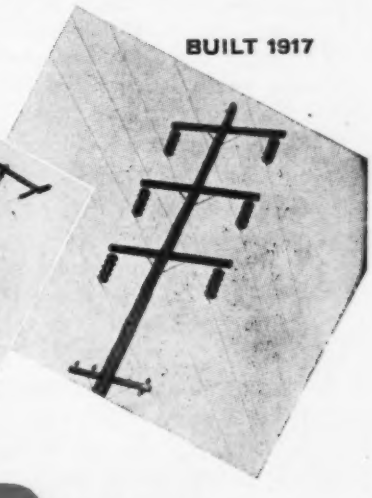
BUILT 1919



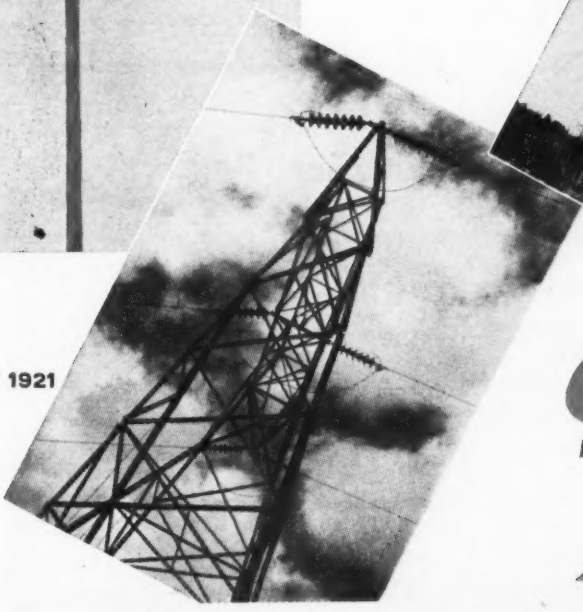
BUILT 1923



BUILT 1917



BUILT 1921



Ohio Brass

MANSFIELD, OHIO

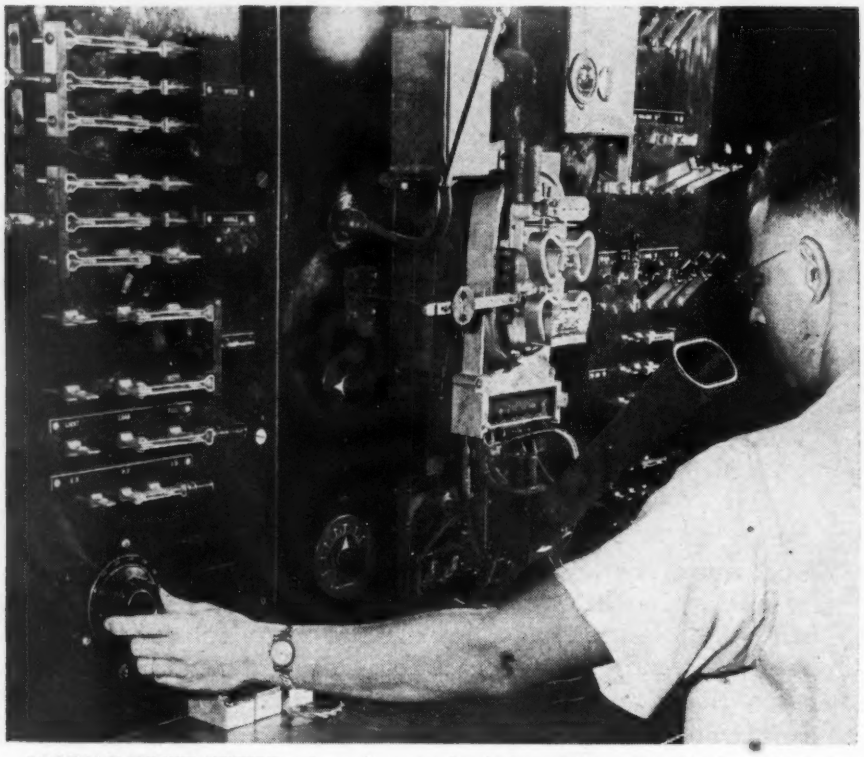
CANADIAN OHIO BRASS CO., LTD.,
NIAGARA FALLS, ONT.

HEADQUARTERS FOR PORCELAIN INSULATION

2658-H

Variac Slows Standard in Balance Test

R. J. McKNIGHT
Central Arizona Light & Power Co., Phoenix

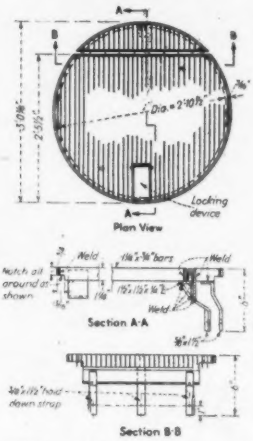


COMPARATIVE SPEED of strobo standard slowed down by Variac which is used in balancing individual elements of polyphase meters

IN TESTING two or three-element polyphase meters it is customary to make an over-all accuracy test with the elements in series, but it is of course necessary to balance the individual elements closely. To do this on the strobo testing board of the Central Arizona Light & Power Co., a Variac in the potential circuit of the standard is used to lower the potential and slow down the standard to match a single element of the meter under test. With this low voltage on the standard it is no longer accurate, but this is of no concern since it is used only to provide a relative speed of rotation to which the individual elements of the meter under test are each synchronized. This Variac feature is an addition to the stroboscopic test equipment normally supplied by the manufacturer.

Gratings Replace Cast Iron Lids

RALPH W. COURSEY
Underground Engineer
Oklahoma Gas & Electric Co.
Oklahoma City, Okla.



HINGED replacement manhole cover for sidewalk vault

OLD STYLE cast iron manhole lids have been replaced with circular grating covers in sidewalk vaults of Oklahoma Gas & Electric Co.

This change improves vault ventilation, provides for easier and safer opening of the manhole, and allows the vault entrance to be locked.

The circular grating for our use is 3 ft. $\frac{1}{8}$ in. outside of grating. A continuous hinge with the top flush with top of grating is provided. The hinged side of door has $1\frac{1}{4}$-in. by $\frac{1}{4}$-in. bar welded to the circular strap around door.

• • •

Lessons from a Substation Fire

A SHORT CIRCUIT to ground in a 4,000-kva. outdoor bank of oil-cooled conservator type transformers, serving an eastern industrial plant with purchased energy, caused an estimated loss of $12,000 and a six-day halt in production pending the installation of borrowed transformers. Energy was supplied at 26.4 kv., three-phase and stepped down to 2,700 volts for plant use. The oil had been sampled for sludge about four months before the short circuit, but no complete change of oil had been made for about nine years. The transformers had been purchased from the power company by the customer.

Late in the evening of the day of the fire an automatic recording oscillograph in the power company's own substation began to operate, indicating an unusual line condition. Three minutes later the primary circuit of the bank was automatically opened by the operation of the ground relay. A piece of the casing lid of a transformer broke off and fell to the ground, and flames rose 20 ft. in the air from the top of the transformer. The oil from one transformer flowed out upon the ground because of a break in a pipe connection and became ignited. It took about 45 minutes to open a loop feeder service on the utility system so that the fire could be fought by the city department without danger from the 26.4-kv. service in the substation structure. Bushings, insulators, copper

tubing, switchgear and bus structure were destroyed; the steel angles in the substation structure were somewhat warped and a concrete mat cracked in several places.

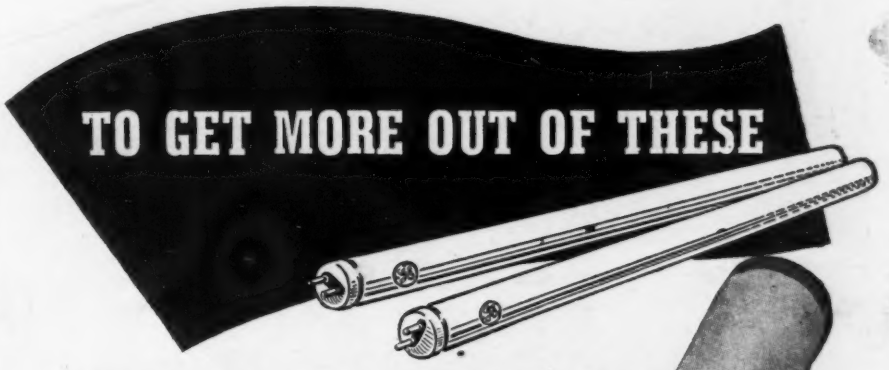
Considerable damage to the transformers took place. An investigation of the trouble led to the conclusion that protection for the bank could be improved by the installation of fixed water spray nozzles above the transformers, no such facilities having been provided in the outdoor substation before the fire. It was also recommended that a spare transformer be made available to shorten the time of any future interruption, since it was necessary for the utility company to tap a 4,150-volt line after rounding up two 200-kva. transformers for temporary service to supply the plant boiler room auxiliaries, air compressor, general lighting and elevators. These smaller transformers were already in service elsewhere and before they could be made available, the load supplied through them had to be disconnected and distributed so that smaller transformers could be used.

Two other lessons of the affair were the importance of giving attention to the drainage of the area surrounding the transformer bank which had been in trouble, the ground being saturated with water and oil after the fire; with the provision of crushed stone about 1.5 in. in size, to a depth of about 8 in., in the drainage area surrounding the transformers and switching equipment.

•

Messengers Carry Heavy Overhead Service Cables

INSTALLATION of 575-volt, three-phase secondary cables from a 1,500-kva., 22-kv. transformer bank fed by the Northern Berkshire Gas Co. to supply energy to the Hoosac Mills, North Adams, Mass., involved an overhead run of about 55 ft. between the transformers and the mill. From the secondary buses six 1,000,000-cir. mil cables (two per phase) are carried about 20 ft. to a pole where a right-angled turn is made toward the mill, 35 ft. distant. Two 4-in. steel angles, set on either side of the pole at a 45-deg. angle and braced to the pole as shown, carry strain insulators which in turn hold terminal clamps



TO GET MORE OUT OF THESE

...BACK 'EM UP WITH ALL THESE

WATCH DOG* STARTERS

Here's the starter for fluorescent lamps that eliminates *blink and flicker.* A "cut out" opens the circuit when lamps reach the end of their useful life. Outlasts ordinary starters 5 to 1. Simplifies maintenance and relamping. Types for lamps from 15-to 100-watts.

ROTATING LOCK LAMPHOLDERS

Among G.E.'s full line of lampholders for fluorescent fixtures, this is the most popular type. When lamps are inserted and rotated, they *lock* into place. Made in white or black plastic in mounting combinations to meet the needs of any standard fixture.

TWIN TURRET LAMPHOLDERS

A strong, practical support for two 40-watt lamps and starter. Each lamp is inserted by depressing either face of holder until lamp end snaps into position. Twin Turret Lampholders are easily mounted on any flat surface.

SLIMLINE LAMPHOLDERS

These white plastic lampholders are styled and finished for modern fluorescent fixture lighting with the new Slimline Lamps. Lamps are easily inserted, firmly held. Companion types are particularly suited for narrow channel mounting.

*Trade-mark Reg. U. S. Pat. Off.

For information on these and other G-E accessories for fluorescent lighting (including the new Circline accessories), write Section D 21-99, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

BALLASTS—LAMPS—STARTERS
LAMPHOLDERS—CABLE
for dependability in fluorescent lighting

GENERAL ELECTRIC

You can cut and fit TRANCELL . . . to suit your space and requirements

Unusually Workable, this strong, asbestos-and-cement housing comes in large sheets that can be cut, drilled and bolted right on the job . . . is rotproof and rustproof, requires no painting . . . and little, if any, upkeep.

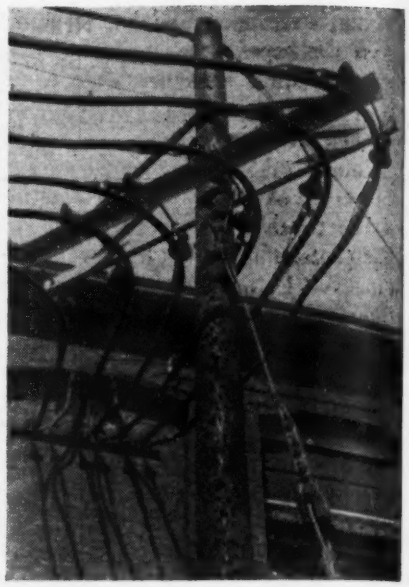
Dry-Constructed. Trancell housings are erected without water . . . make a neater and faster job. Non-metallic, Trancell reduces the danger of shorts due to condensation. Its low conductivity protects adjacent equipment against heat transmission. Fireproof, it confines oil fires to the cells in which they originate.

Lightweight, Trancell doesn't overload balconies and upper floors. Barriers and shelves of this material, though strong, are unusually light in weight. Excellent for alterations, it can be built around your present equipment quickly and economically. A complete line of hardware for Trancell doors is available.

Johns-Manville supplies Trancell cut to special dimensions, or, if you prefer, you may cut it in your own plant as most maintenance departments do . . . saving shut-down time, numerous detail drawings and materials. For full details, write Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCT

Johns-Manville TRANCELL
an asbestos product . . . for housing electrical equipment



SIMPLE strain insulator, steel angle and messenger construction supports six 1,000-000-cir. mil cables at factory entrance with economical use of material

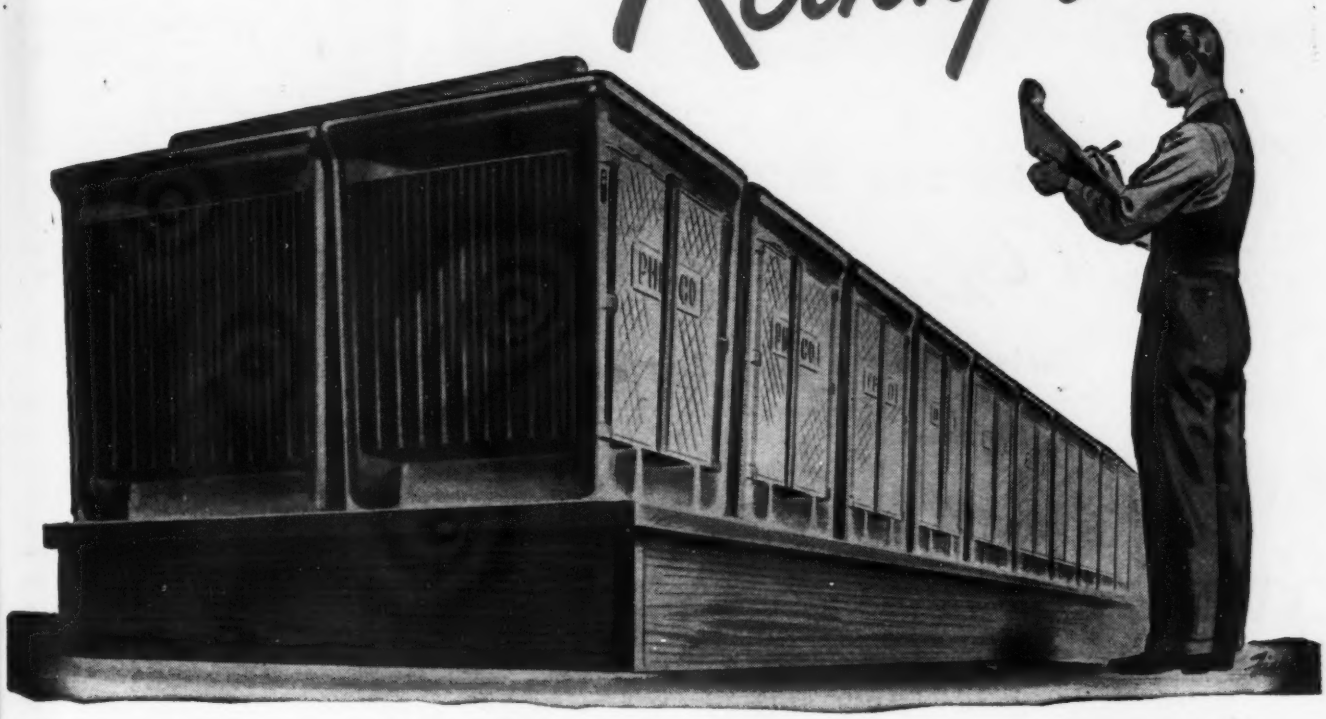
supporting ⅜-in. stranded steel messenger wires, one per cable, which support the cables through the entire run. At the factory wall the cables are dead-ended on strain insulators, and taps led through an insulated barrier in the wall to a switchboard center within the building. The secondary lead cable pole is heavily guyed, as shown, and the layout was quickly installed, avoiding the use of underground construction with associated potheads and lessened accessibility.

•

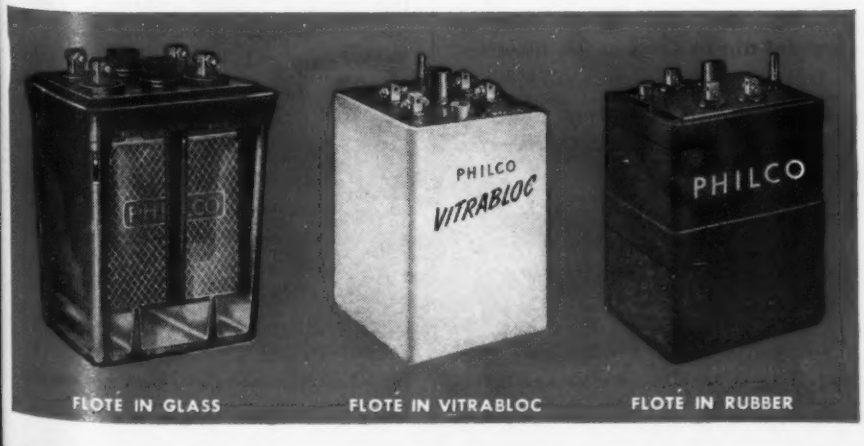
Demountable Hoist for Manhole Tanks

To FACILITATE handling oil reservoirs in manholes in the installation of the new 110-kv. cable between Mystic and Woburn stations, the Boston Edison Co. designed a demountable hoist as illustrated herewith. When empty these tanks weigh about 300 lb. After the hoist components have been assembled in the vault as described in connection with the perspective drawing, the empty tank is lowered end-upward into the vault by a truck crane, the hoisting slings are rearranged and the reservoir raised to a horizontal position. While the tank is being held horizontally in the upper part of the manhole, the manhole hoist is adjusted to a convenient height and centered under the reser-

Is Your Battery Room Ready?



Do you have adequate auxiliary power and control facilities for the expanded service you are planning? Are battery replacements, new batteries, new layouts needed? Philco battery engineers are at your service—ready with more than fifty years of experience in storage battery engineering, planning and installation. Ready with the most modern batteries obtainable—the famous Philco Floté Batteries in glass, rubber or Vitrabloc jars. Write for new catalogs of specification data. Specify Philco. PHILCO CORPORATION, Storage Battery Division, Trenton 7, New Jersey.



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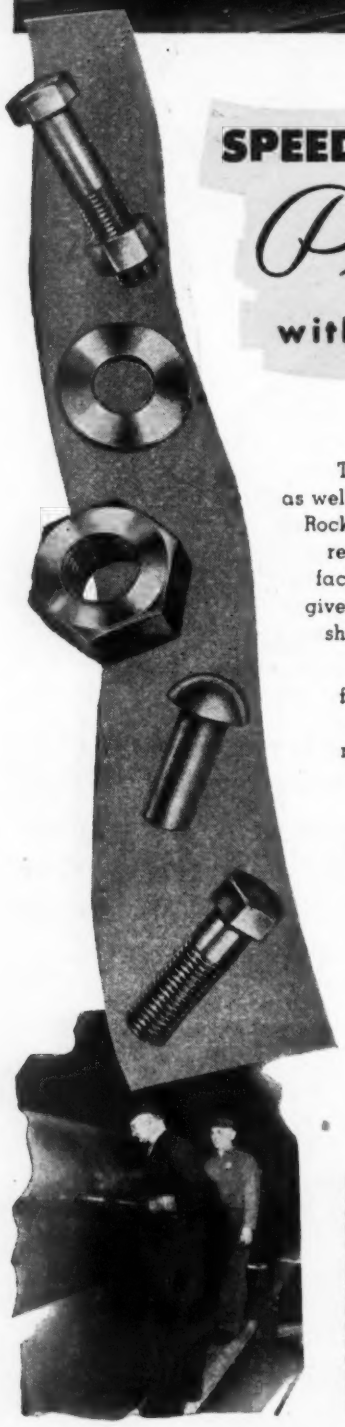
FOR 50 YEARS A LEADER
IN TELEPHONE
BATTERY DEVELOPMENT

The Rocky Mountain Rocket of the Rock Island Lines.



SPEED and DEPENDABILITY

Plus Styling

with Everlasting Fastenings

The Public demands modern appearance . . . style as well as performance. The famous Rocky Mountain Rocket of the Rock Island Lines amply meets these requirements. The Pullman-Standard Car Manufacturing Company, builder of the Rocket Pullmans, gives its cars up-to-the-minute styling with stainless steel sheeting fastened with stainless steels crews.

More and more products every day turn to stainless for modern styling—railroads, food equipment, appliances and many others . . . and more and more manufacturers look to Harper for stainless steel fastenings which resist rust and corrosion.

Harper maintains a stock of 4850 types of *Everlasting Fastenings*—Bolts, Nuts, Screws, Washers and others, fabricated from Brass, Naval Bronze, Silicon Bronze, Monel and Stainless Steel. Special engineering facilities serve product manufacturers through Harper factory branches and distributors in principal cities.

THE H. M. HARPER COMPANY

2611 Fletcher Street • Chicago 18, Illinois

Branch Offices: New York City, Philadelphia, Los Angeles, Milwaukee, Cincinnati, Dallas Representatives in Principal Cities

The Pullman-Standard Car Manufacturing Company applies Stainless Steel sheeting to one of its modern passenger cars with Harper Stainless Steel Rivets.

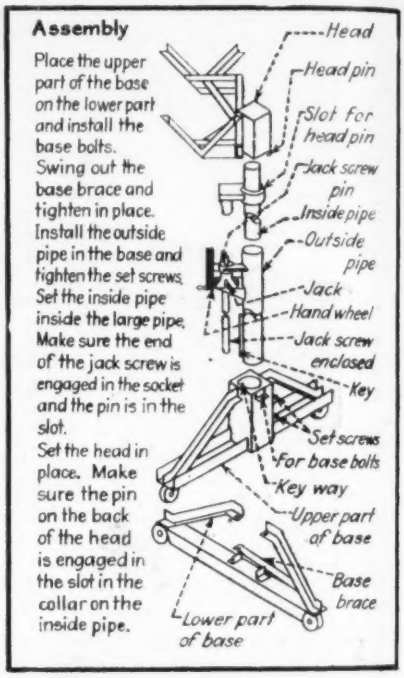
HARPER

Everlasting Fastenings

Chicago

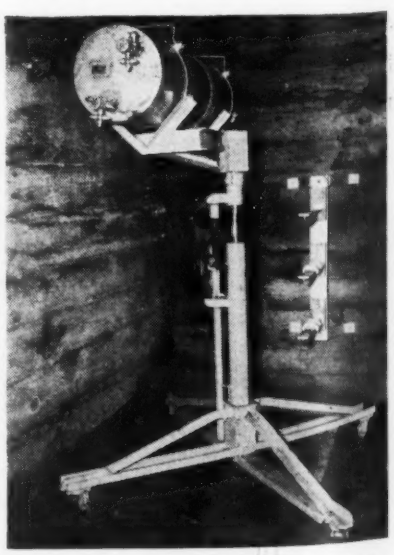
BRASS • BRONZE • COPPER • MONEL • STAINLESS

voir. The tank is aligned with relation to its final position in the manhole, the hoist being placed with its head aligned with the tank. The tank is then gently lowered to the hoist; the slings are removed from the tank and the hoist rolled to that point in the manhole where the mounting lugs on the reservoir are directly under the mounting brackets on the manhole

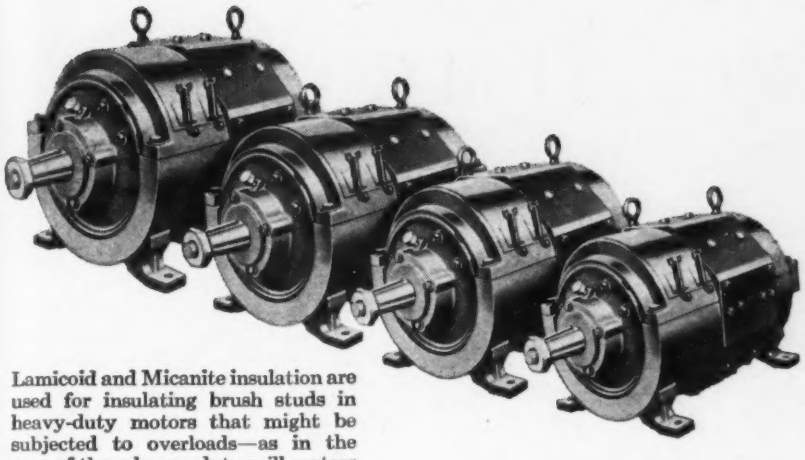

Assembly
Place the upper part of the base on the lower part and install the base bolts.
Swing out the base brace and tighten in place.
Install the outside pipe in the base and tighten the set screws.
Set the inside pipe inside the large pipe. Make sure the end of the jack screw is engaged in the socket and the pin is in the slot.
Set the head in place. Make sure the pin on the back of the head is engaged in the slot in the collar on the inside pipe.
Head
Head pin
Slot for head pin
Jack screw pin
Inside pipe
Outside pipe
Jack
Hand wheel
Jack screw enclosed
Key
Set screws for base bolts
Key way
Upper part of base
Base brace
Lower part of base

VIEW of oil reservoir hoist component parts with particulars of assembly in the field

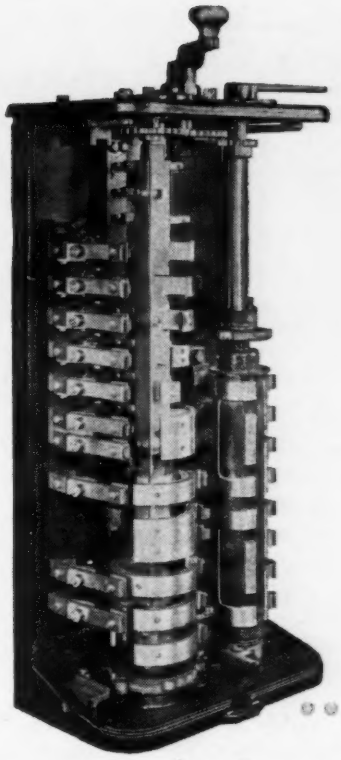
roof. The tank is then raised to its final position by operating the hand wheel on the hoist, bolts and lock washers inserted and tightened. The hoist is then demounted and removed from the manhole.



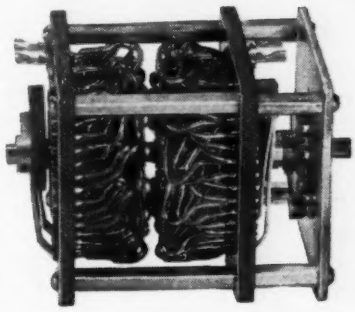
OIL RESERVOIR in manhole raised to upper level by hoist



Lamicoid and Micanite insulation are used for insulating brush studs in heavy-duty motors that might be subjected to overloads—as in the case of these heavy-duty mill motors manufactured by the Harnischfeger Corporation.



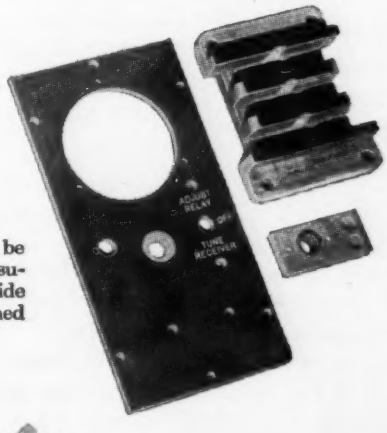
Lamicoid plastics and Micanite tubing are utilized for insulation on this drum controller which is used on many mine locomotives made by Goodman Manufacturing Company.



Canvas-back Lamicoid is used as the insulating material on potentiometers made by the Daven Company. NEMA grade xxxp Lamicoid has low dielectric loss, can be easily punched and is excellent for high frequency applications where high humidity is indicated.

Lamicoid has a high dielectric strength and is suitable for both high and low voltages. It has low moisture absorption and low power factor. Sheets are available in all electrical and mechanical grades, in standard sizes of 36″ x 42″.

Because we carry a *complete* line of all types of insulation materials, you can always be sure our recommendations are unbiased and that we can supply you with an insulating material that will solve your problems. And 50 years of practical experience back every suggestion that the Mica Insulator Company makes!



Lamicoid is a versatile material that can be used for its structural strength as well as insulating properties . . . and is available in a wide variety of grades that can be sawed, punched or machined.

MICA *Insulator* COMPANY

Schenectady 1, N. Y.

SALES OFFICES: Boston: 285 Columbus Avenue • Chicago: 600 West Van Buren Street • Cincinnati: 3403 Hazelwood Avenue Cleveland: 1276 West 3rd Street • Detroit: Book Building • Los Angeles: Western Fiberglas Supply, Ltd., 937 South Grand Ave. New York: 200 Varick St. • St. Louis: 455 Paul Brown Building • San Francisco: Western Fiberglas Supply, Ltd., 739 Bryant St. Philadelphia: 1119 Real Estate Trust Building • Rochester: 817 Commerce Building

FABRICATORS: Lamicoid Fabricators, Inc., 3600 Potomac Avenue, Chicago, Ill. • Insulating Fabricators, Inc., 69 Grove Street, Watertown, Mass. • Insulating Fabricators, Inc., 12 East 12th Street, New York City • Bakoring, Inc., 1020 Houston Avenue, Houston 10, Texas

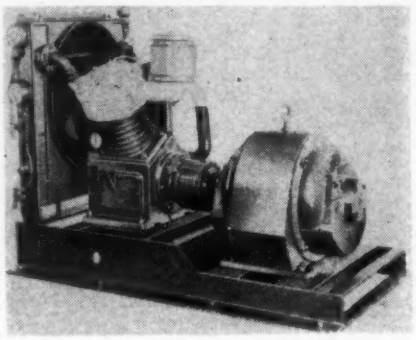
NEW EQUIPMENT

Departmental Compressor System Announced by Davey

PRODUCTION of a new line of industrial "Departmental" compressors was announced recently by Paul H. Davey, president, Davey Compressor Co., Kent, Ohio. These new units are available in 60-105-160-210-315 c.f.m. sizes.

In connection with this announcement of the new line, Mr. Davey outlined a complete new plan for industrial air compressor installations—the departmental system. This is a departure from the conventional "central" system where a large compressor pipes air to various departments. Under the departmental system, for example, if six departments require compressed air, six separate compressors of proper capacities are installed. Each operates independently but several units are connected together to provide a power reserve for overpeak loads, or maintain service in case of breakdowns.

The departmental system, according to Mr. Davey, is designed to meet the immediate needs of two large groups of compressed air users. One group is composed of industries which "discovered" the versatility of compressed air during war-time production operations and are now expanding their air facilities. The other group, with compressors worn through war-time operations, has this machinery at the top of its replacement list.



Mr. Davey listed the following advantages and savings inherent in the departmental system: 1, eliminates pressure losses common to long distance "piping" of air; 2, requires less power to "push" air from compressor to job; 3, lower installation cost; 4, departmental compressors work only when individual departments need air; 5, permits adjustment of pressure and air supply to exact point of efficiency for each job; 6, departmental system can be easily and economically expanded by simply adding another unit; 7, eliminates shutdowns due to central compressor failure; 8, eliminates need for emergency standby compressors; 9, permits use of air-cooled instead of water-cooled units; 10, cuts repair costs. Departmental units are mass produced; parts are readily available.

•

Puller Motor and Gears Are Integral Unit

ELECTRIC capstan car puller, in which the gearing is integral with the motor, has been announced by Silent Hoist Winch & Crane Co., 841 63rd St., Brooklyn, N. Y. It is available in a 7½-hp. size with a capacity of 5,000 lb. drawbar pull and a 15-hp. size with a capacity of 10,000 lb. Stock units are available for 220/440-volt, 3-phase, 60-cycle circuits and for d.c. service on application.

•

Cascade Phase Shifter Provided in FM Transmitters

COMPLETION of the development work and application of a new type of frequency modulator in all types of FM transmitters has been announced by Raytheon Mfg. Co., 60 East 42nd St., New York 17, N. Y. The new modulator, called a Cascade Phase Shifter, is said to improve operation and provide for simplicity.

The phase shifter uses standard types of tubes. By means of a single low-frequency crystal, direct crystal control of the carrier frequency is obtained which requires a multiplication of only 972. Noise and distortion are reported below the limits set by FCC for FM transmitters. Simplicity of circuit is said to provide ease of adjustment, minimum of maintenance, and low tube cost.

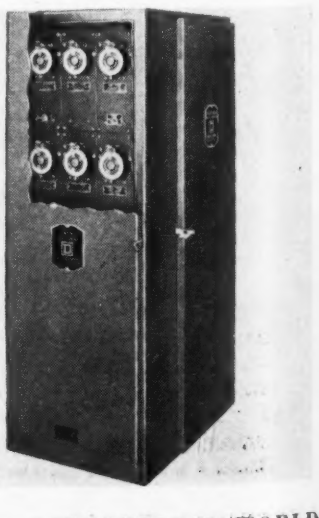
•

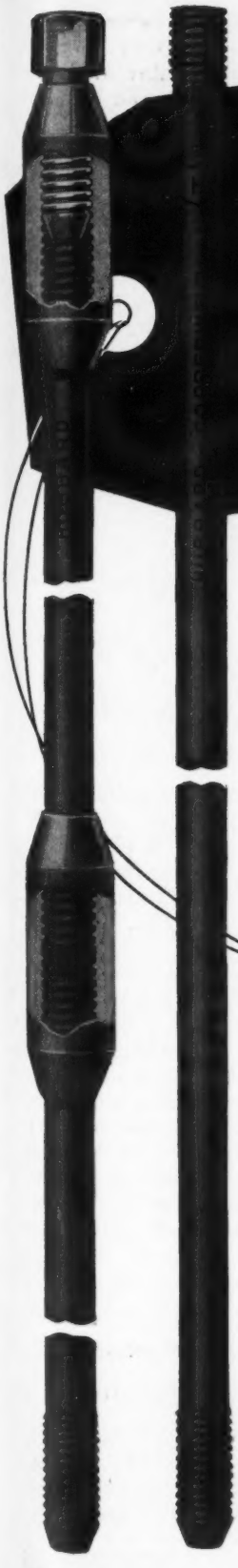
Welder Contactor-Timer In Single Unit

A NEW Class 8992 combination control unit, designed to meet recently adopted NEMA Standards for resistance welder control, has been announced by Square D Co., 4041 North Richards St., Milwaukee 12, Wis.

A Syncro-Break welder contactor and Safront sequence-weld timer are both included in a single enclosure arranged to mount on the right hand side of the machine with all control elements within easy reach of operator. More convenient adjustment, better appearance, less expensive and more flexible installation, and safer operation result, the manufacturer states.

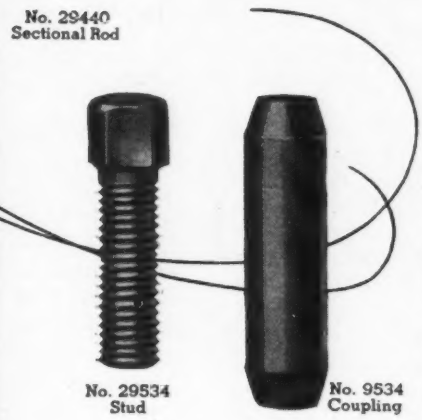
Conduit and fittings are minimized because contactor and timer interwiring is already provided. Fuse protection of all control circuits is included. Foot switch, pressure switch, no-weld switch and timer control circuits operate at 110 volts and are isolated from the power



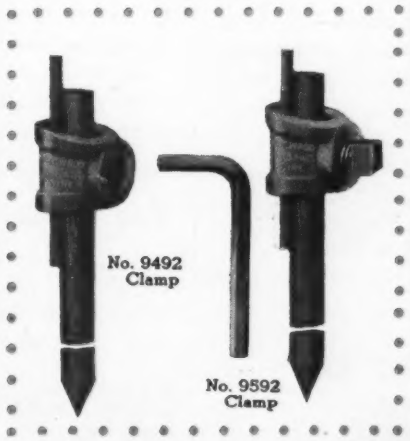


The Endurance of Copper-Plus The Strength of Steel

HUBBARD-COPPERWELD SECTIONAL GROUND RODS



Hubbard-Copperweld Sectional Ground Rods have been designed for use in locations where deep grounds are necessary to reach firm soil. The use of sectional rods eliminates the nuisance of extra long rods which are clumsy to handle in the warehouse and on the truck. Sectional rods are the same as standard except that they are threaded on each end. Joining is accomplished by couplings as shown. For driving purposes a stud bolt is inserted in the coupling at the top of each section.



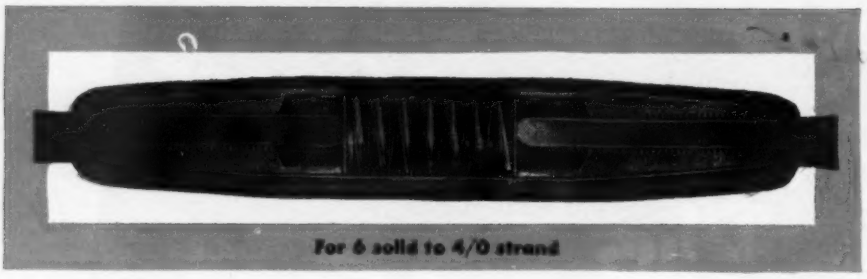
Assembly of Sectional Rods—Couplings and Stud

Stock No.	Description	Size	Approx. Wt. per 100 Pcs.
29430	Sectional Rod	1/2" x 10 Ft.	550
29440	Sectional Rod	5/8" x 10 Ft.	860
29450	Sectional Rod	3/4" x 10 Ft.	1220
9533	Coupling	1/2"	18
9534	Coupling	5/8"	30
9535	Coupling	3/4"	46
29533	Stud	1/2"	15
29534	Stud	5/8"	23
29535	Stud	3/4"	35
9491	Safety Set Screw Ground Clamps	1/2"	25
9492		5/8"	35
9493		3/4"	45
9591	Sq. Head. Set Screw Ground Clamps	1/2"	25
9592		5/8"	35
9593		3/4"	45

HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

EXCLUSIVE NATIONAL SALES AGENTS FOR COPPERWELD GROUND RODS AND CLAMPS



Here's why many linemen prefer FARGO Automatic Line Splices

Fast, trouble-free installation saves time and effort

In fair weather or foul, in a pole-top maze or in the clear, linemen want *and need* splices that go on fast and stay on tight. And they tell us they want a splice that does not require extra tools. Fargo automatic line splices are designed from on-the-job research to meet those requirements.

1 **No extra tools needed**—Both hands are free to make splices.

2 **Automatic installation**—When wire is inserted, the four-jaw gripping unit automatically adjusts to the conductor and holds solid or stranded wire in permanent, vibration-proof grip.

3 **Sag guide**—Shows how much of the conductor should go inside the splice.

4 **Safety zone**—Accommodates burred and upset wire ends. Stop plate prohibits wire from becoming entangled with spring.

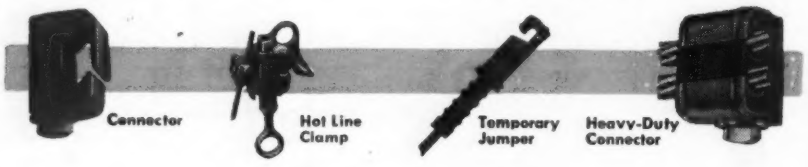
5 **Easily inspected**—Position and condition of wire may be observed through release slot.

6 **Easily disconnected**—Screwdriver in release slot holds jaw open until wire is removed.

7 **High conductivity**—Heavy body of solid copper affords greater conductivity than an equal length of conductor.

8 **Dependable service**—Whole jaw assembly is made of one piece of metal, so gripping teeth automatically keep in line. Phosphor bronze spring exerts ample pressure even under severe alternating tension such as that occurring under whipping wind action.

9 **High salvage value**—Splices may be used again and again. All parts are corrosion and weather resistant.



Full Fargo Line Distributed by

LINE MATERIAL COMPANY, MILWAUKEE, WISCONSIN

(Representatives in principal cities)

FARGO MFG. COMPANY, INC.

ESTABLISHED 1914

Poughkeepsie, N. Y.

supply. A metal barrier between contactor and timer sections of the enclosure eliminates possibility of flashover between the power and control circuits.

Combination controllers are designed with a control circuit which may be either separate or common with the power circuit. Solenoid air valve may be energized from either the power or control supply sources by simple reconnection. Standard controllers have tapped primary control transformers which can be connected for operation at 110, 220, or 440 volts, 60 cycles; or for 380 volts, 50 cycles. Other voltages and frequencies are available on special order.

Space and terminals are provided within the standard controllers for additional features such as 24-volt initiating switch control, two-stage pilot switch control, or 24-volt, two-stage pilot switch control.

•

2,500-Lumen, 6.6-Amp. Street Light Smaller in Size

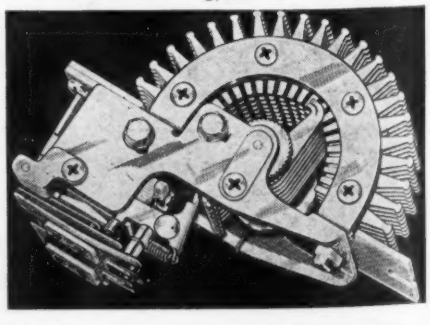
AN IMPROVED street light bulb, which is smaller in size and which, the developers state, has the light output of the larger bulb sizes with corresponding wattage, is being announced by Sylvania Electric Products Inc., 500 Fifth Ave., New York, N. Y.

The lamp, designated PS-25, has a 2,500-lumen, 6.6-amp. rating and is available in both regular and group replacement life types. The regular lamp has a laboratory life of 2,000 hours with an average voltage of 21.7 while the group replacement lamp tests for 3,000 hours at 23.0 average volts. Both lamps have characteristics common to the larger PS-35 lamp. The bulb is designed for use in existing radial wave reflectors.

•

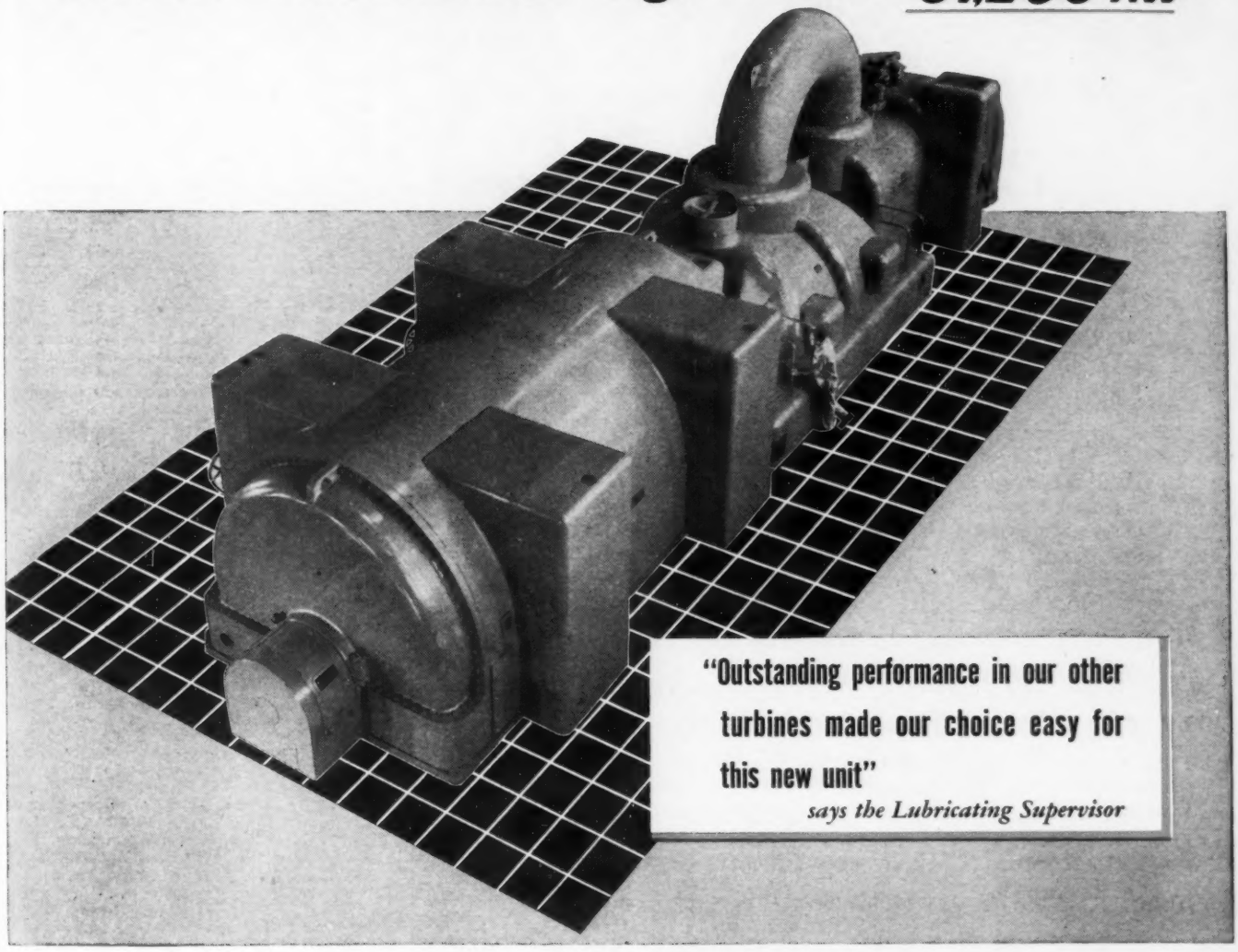
Stepping Switch Performs Four Types of Operations

A SPRING-DRIVEN stepping switch for circuit selection, sequence control, counting, or totalizing operations has been announced by C. P. Clare & Co.,



GULFCREST OIL

selected for another big turbine—81,250 kw



Another big turbine gets the long lasting protection of Gulfcrest, the world's finest turbine oil!

Another case, too, where unmatched performance in other turbines in the same plant narrowed the choice to Gulfcrest Oil for the new unit!

Over 75,000 hours in service in the plant's 40,000 kw. unit, for example, and still providing excellent lubrication—with a very low neutralization number and very little make-up required. Before Gulfcrest Oil was put in service in this unit, conventional turbine oils lasted less than 10,000 hours.

Extra refining makes the difference! Gulfcrest Oil is not only refined by conventional methods, but is super-refined by the Alchlor Process, which weeds out the sludge formers—the undesirable hydrocarbons—in oil. The Alchlor Process also imparts to Gulfcrest Oil greater ability to benefit from the addition of special inhibitors which control oxidation and prevent increase of viscosity.

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to provide the best lubrication for your turbines. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

GULF INDUSTRIAL LUBRICATION

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Please send me, without obligation, a copy of your new booklet "Gulfcrest Oil for Steam Turbine Lubrication."

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Company.....

Title.....

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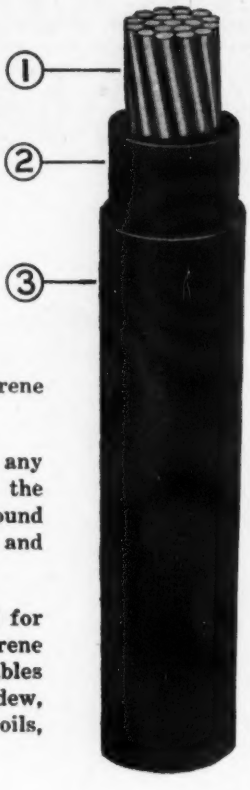
FOR GREATER DOLLAR VALUE

LOOK to ANHYDROPRENE Cables



1. **The tinned copper conductors of Anhydroprene cables may be either solid or stranded.**
2. **Anhydrex, the lowest water-absorptive of any wire and cable insulation, effectively prevents the troubles caused by the presence of water around cable operations. It has good aging properties and a high dielectric strength.**
3. **A thin jacket of Neoprene eliminates the need for outer braids or tapes and makes Anhydroprene ideal for use in ducts or wherever other cables become ineffective due to fungus growth, mildew, or rot. Excels in its resistance to sunlight, oils, and flame.**

DO THE HIGH costs of materials and labor that exist today make you hesitant about buying the power cables you need? Why not learn now how Anhydroprene Cables can increase the value of each dollar you spend?

Their simple 1-2-3 construction consists of copper conductors insulated with the famous Simplex-Anhydrex compound, and a protective jacket of Neoprene. This Anhydrex-Neoprene combination assures long life with trouble-free service — the thrifty solution to problems of installation where ordinary cables now demand important dollars for repairs and eventual replacement.

Get acquainted with Anhydroprene today and you will realize greater savings from your future cable investments.

Write for Data Sheet No. 115, an informative bulletin describing Simplex-Anhydroprene Cables.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

4719 West Sunnyside Ave., Chicago 30, Ill.

The switch consists essentially of one or more wiper springs, fixed on a shaft rotated by a pawl and ratchet mechanism. This mechanism is actuated by an electromagnet which responds to momentary current impulses. When the magnet is deenergized, the wiper assembly is driven forward by the spring. The framework and armature are finished in cadmium; bank contacts and wipers are phosphor bronze.

TECHNICAL LITERATURE

Lightning Arresters—Expulsion Type Distribution Lightning Arresters, proposed A.I.E.E. standard No. 47 for trial use, is available from American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y. These standards apply to all types of expulsion arresters designed to limit voltage surges for the protection of 60-cycle distribution apparatus. They do not apply to the protective tubes used on transmission lines as covered in A.I.E.E. standard No. 24, nor to expulsion type arresters supplied integrally with transformers.

Shipboard Installations—Recommended Practice for Electric Installations on Shipboard, a 120-page 1945 revision, is available from the American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y., for $2.00 per copy. It is a guide for equipping vessels with lighting, signaling, communication, and power apparatus and covers both d.c. and a.c. equipment.

Control Equipment—Automatic Station Control, Supervisory, and Telemetering Equipments Standards, C37.2-1945, are available from the American Standards Association, 70 East 45th St., New York 17, N. Y., for 40 cents per copy. The standard applies to the performance and applications of devices when used for automatic control, supervisory control, telemetering, and supervisory indication of electric power or conversion apparatus.

Electrode Identification—Standard for Color Markings for Electrode Identification, publication No. 45-108, is available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for 10 cents per copy.

Circuit Breakers—Large Air Circuit Breaker Standards, publication 46-109, are available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for $2.50 per copy. The standards cover air circuit breakers in ratings ranging from 1 to 10,000 amp. d.c., 750 volts or less, and 1 to 6,000 amp. a.c., 600 volts or less, single pole and multipole. It does not include super high-speed magnetic blowout breakers. It also covers certain special air circuit breakers and attachments.

Roasters—Standards for Roasters, publication No. 46-115, is available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for 30 cents per copy. It covers both rating and performance standards.

Plastics—Recommended Practice for Fabricating Laminated Plastics, publication 45-107, is available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for 25 cents per copy. It is designed as a guide from the cutting-off operation through to the finishing operations.

NEWS ABOUT PEOPLE

Richard N. Larkin Named Associate Editor of World

Richard N. Larkin, who covered Washington for ELECTRICAL WORLD during the war and the period following,

R. N. LARKIN

has been transferred to the New York office with the rank of associate editor. In his new position, he will be responsible for editorial material, including news coverage, in the magazine involving the political, economic, labor, and social concerns of the electrical industry.

Though only 31 years old and believed to be the youngest associate editor in the 72 years of ELECTRICAL WORLD, Mr. Larkin has had considerable experience in news reporting. Following his graduation from Lehigh University in 1938, he joined the staff of the *Morning Free Press*, Easton, Pa. After eleven months, he went to Harrisburg, Pa., as a reporter for the *Patriot*. About a year later, he joined the Harrisburg bureau of the United Press and covered Capitol Hill including the statehouse, the Public Utility Commission, and other departments of the state government.

In July, 1942, he came to New York as a member of the staff of *Product Engineering*, a McGraw-Hill publication, and in October, 1942, he was sent to Washington as a member of the McGraw-Hill News Bureau. When George Doying entered the Marine Corps in May, 1943, Mr. Larkin was assigned chiefly to ELECTRICAL WORLD but did work for other magazines including *Power* and *Electrical West*.

During the war days when government regulations were so important to utilities, Mr. Larkin kept readers informed with his interpretative stories slanted directly to the industry. He also wrote "Washington Comment," a biweekly feature of the magazine, and secured the information needed in preparing editorials based on stories originating in the nation's capital.

The successor to Mr. Larkin at Washington will be announced later.

•

Seattle Light Names Olson Operations Engineer

W. J. Olson has been placed in charge of the operating division of Seattle City Light in the capacity of power operations engineer, succeeding B. C. Mooers, retired.

Mr. Olson has spent 30 years with City Light, excepting time out for service in

W. J. OLSON

the First World War. Starting in 1917, he advanced by successive promotions, in 1919 becoming a junior operator, then operator, senior operator, load dispatcher and senior power dispatcher. His recent appointment followed.

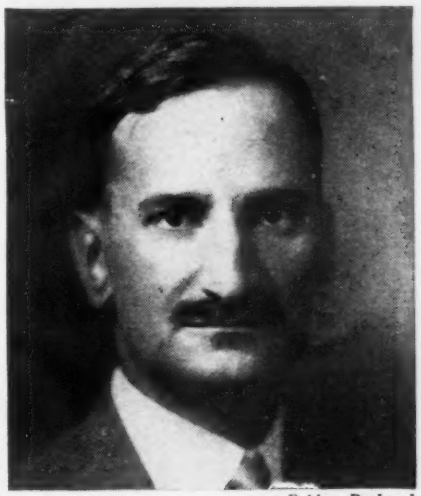
Mr. Olson has a degree in electrical engineering from the University of Washington.

•

► D. O. MCKEE of White Hall, S. C., has been elected president of the Kaufman County Electric Cooperative, Inc., Kaufman, Tex.

NBS Names Silsbee Chief, Division of Electricity

F. B. Silsbee is the new chief of the Division of Electricity, National Bureau of Standards. E. C. Crittenden, chief of the division for 25 years, is now devoting his entire time to his duties as assistant director of the Bureau.



Fabian Bachrach

F. B. SILSBEE

Dr. Silsbee has been connected with the electrical instruments section in the electricity division for 35 years and has been chief of the section since 1939. He has devoted particular attention to methods of testing current and voltage transformers and has contributed both theoretical and experimental studies in the field of superconductivity. He has published many papers on these subjects in NBS publications and technical journals.

His service covers both World Wars; in each he engaged in research on important military problems. During the First World War he was in charge of ignition apparatus and aircraft engines and contributed to theory of operation of high-tension magneto. In the Second World War he directed studies of hazards to aircraft and gliders operating in or near thunderstorms, and took an active part in other projects.

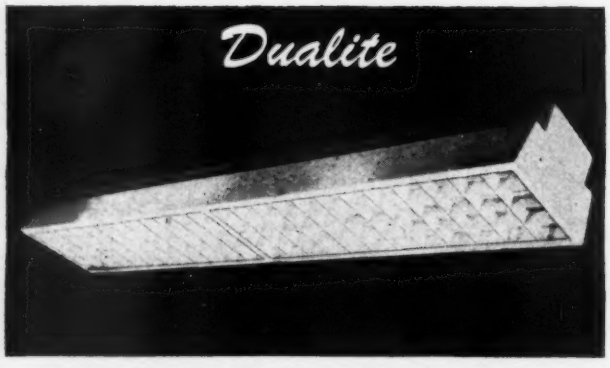
Dr. Silsbee has served on many committees of the A.I.E.E., and the American Standards Association and on the National Advisory Committee on Aeronautics. At the present time he is chairman of ASA committee C-12 on electrical meters. In 1938 he represented

Now Cold Cathode

in a *FULL RANGE* of

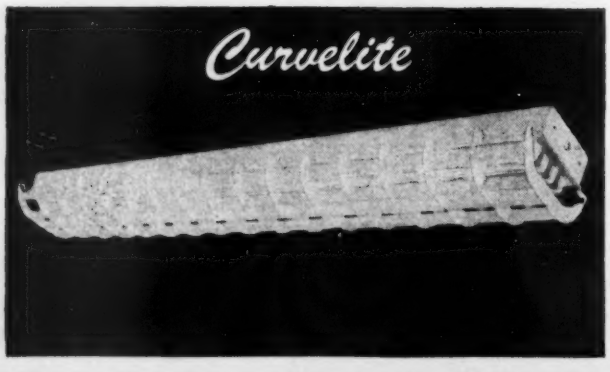
Federal's time-tested and precision engineered ZEON Fluorescent Lighting insures dependable performance and longer life. Mass production methods minimize cost.

Lamps and fixtures, available for immediate delivery, are fully guaranteed for one year (except lamp breakage). Ask your contractor or write direct to the Federal Electric Company, Inc., 8700 S. State Street, Chicago 19, Illinois.



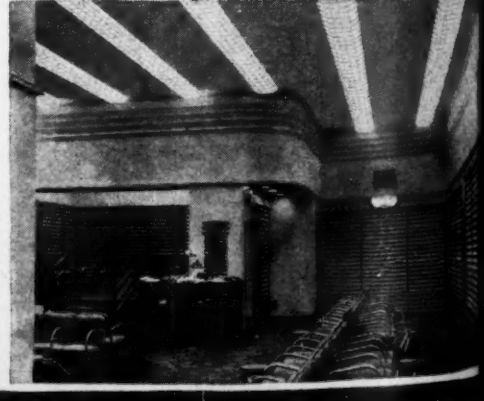
HOOD ACCESSORY

May be used as an open troffer or with flat louvers or diffusing "Sky-Tex" glass panels. Openings along the sides of the fixture permit light to be reflected to the ceiling as well as downward. Suitable for surface or suspension mounting.



CURVED ACCESSORY

Attractive curved louvers, for those who prefer partially concealed lamps, reduces brightness contrasts with minimum loss of efficiency. Louvers have hinging action for lamp accessibility. Suitable for surface or suspension mounting.



FEDERAL ELECTRIC

ZEON

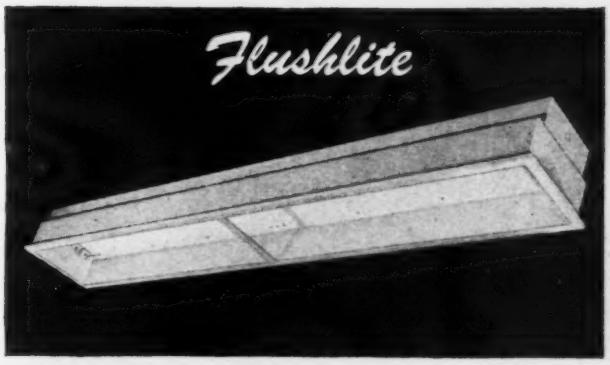
FLUORESCENT LIGHTING UNITS

IMMEDIATELY AVAILABLE

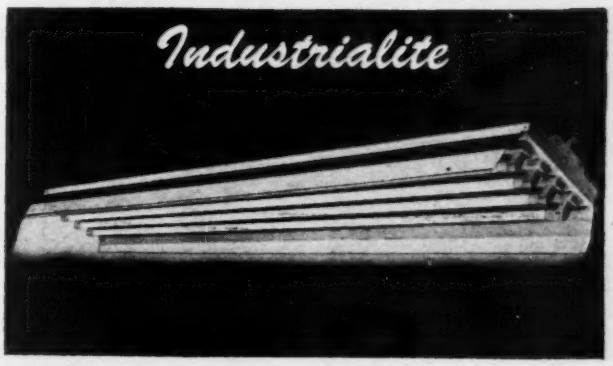
f attractive FIXTURE TYPES

FLUSH ACCESSORY

Ideal for that recessed installation. Reflector easily detachable for cleaning without disturbing sockets or wiring. May be used open or with flat louvers or diffusing "Sky-Tex" panels.



Extremely high reflector effiency—over 91% in 4-lamp unit. May be installed as single 8′ units or in continuous rows. One single outlet will service 72′ of 4-lamp units.



Ultimate in simplicity—for stem or surface mountings. Minimum of fixture bulk, sockets and ballast concealed in easy to mount housings. May be used in continuous rows to reduce service wiring requirements. Only one outlet required for 72′ of 4-lamp units.

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LONG LIFE DOUGLAS FIR POLES

BAXCO Long-Life Douglas Fir poles are pressure treated and stocked at three strategically located plants. *Shipments direct from the timber producing country of Oregon are being made to Mid-West and Eastern buyers from the new pressure creosoting plant of J. H. Baxter & Co. of Oregon at Eugene, Oregon. *Two large pressure treating plants and storage yards are operated by J. H. Baxter & Co. at Alameda and Long Beach, California. Facilities are available at our California plants for both rail and water shipment via San Francisco and Los Angeles Harbors. Cargo shipments are also made through the Port of Portland, Oregon.

BAXCO Long-Life Douglas Fir poles meet ASA Specifications and are pressure-treated with coal-tar creosote or creosote-pentachlorphenol solution by the empty cell process, 8-lb. retention, in accordance with AWPA Specifications.

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the National Bureau of Standards at the International Electrotechnical Commission in Torquay, England. He is a member of the American Physics Society, American Association for the Advancement of Science and of other technical societies.

•

J. B. French New President of Rocky Mountain Group

J. B. French, who was recently elected president of the Rocky Mountain Electrical League (ELECTRICAL WORLD, September 14, page 108), organized the Black Hills Power & Light Co., Rapid City, S. D., in 1941. At the present time he is president, general manager and chairman of the board of directors.

J. B. FRENCH

A native of Missouri, Mr. French entered the utility field with the Carthage Gas & Electric Co. in 1912 and two years later transferred to the Webb City Gas & Electric Co. His next connection was with the Ft. Scott (Kans.) Gas & Electric Co., serving as stores clerk, merchandise manager, distribution superintendent and assistant general manager. In 1921 Mr. French went to Brinkley, Ark., as division manager for Arkansas Utilities Co. and three years later to Marlin, Tex., as division manager for Texas Utilities Co.

It was in 1929 that Mr. French first went to the Dakotas as general manager for Dakota Power Co. at Rapid City, S. D. In 1937 he was made president of Dakota Power Co. and went on the board of directors of General Public Utilities Co., which South Dakota properties were combined in the formation of the Black Hills Power & Light Co. in 1941.

•

► R. L. DUNSHEE has been made commercial manager of the Sacramento Municipal Utility District, ending a 20-year tenure with the Pacific Gas &

To the editorial theme of this issue

"Best Ways to sell Best Lighting"

Add...

—the best basis for industry procedures —best exemplified in the lighting field:

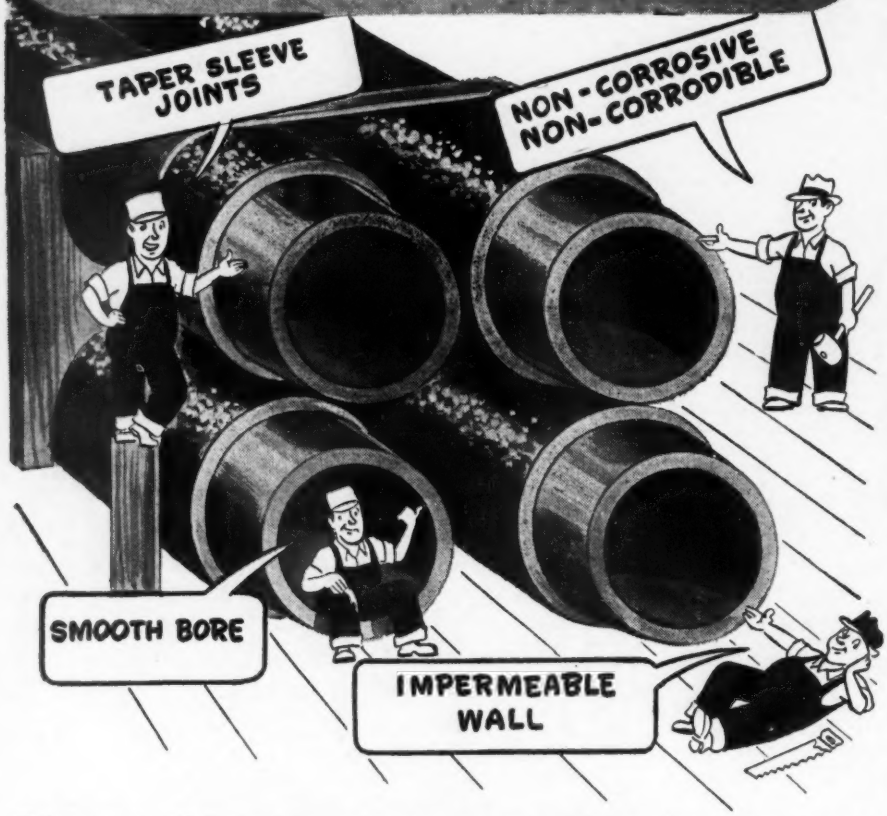
1. **SPECIFICATION**
   calling for excellent performance
2. **TEST**
   that is through-going reliable and preferably independent
3. **CERTIFICATION**
   (where desired) to evidence test-proven compliance with specification

The Mark of ETL CERTIFIED Certification

ELECTRICAL TESTING LABORATORIES INC

2 EAST END AVENUE AT 79TH STREET · NEW YORK 21, N.Y.

GUARDING THE LIFELINE with 4-way protection!



Cable is the lifeline of power and communications systems. Give it this vital 4-way protection with ORANGEBURG* CONDUIT . . . .

1. **Protection** from cable sheath abrasion . . . because of its smooth bore, ORANGEBURG reduces the danger of damage to the sheath when cable is pulled into duct.

2. **Protection** from pulling tension . . . because the friction coefficient is lower in ORANGEBURG than in ducts made of other materials, lessening strains caused by cable pulling tension.

3. **Protection** from water infiltration . . . because ORANGEBURG'S impermeable wall gives cables maximum safety from ground water and resulting corrosion.

4. **Protection** with cable movement . . . because the smooth surface of ORANGEBURG reduces wear on the sheath as the cable expands and contracts with changing loads. *Write for the Catalog today.*

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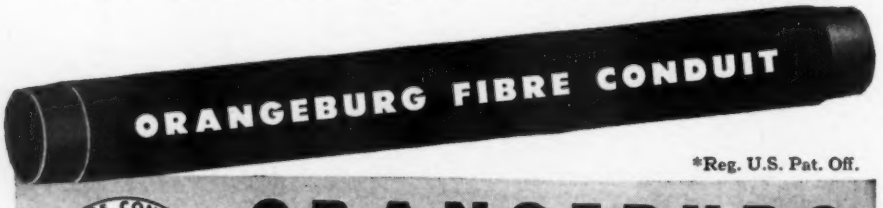

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THE FIBRE CONDUIT CO. REG. U.S. PAT. OFF. ORANGEBURG N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

Electric Co. in accounting and purchasing capacities. Mr. Dunshee was employed in anticipation of the January 1 takeover by the district of the P.G. & E. distribution system in the area.

•

Consumers Power Makes New Division Appointments

Consumers Power Co. has recently announced several changes in its division headquarters organization.

Hubert G. Holmes has been appointed superintendent of the western division with headquarters at Grand Rapids. He succeeds LeRoy L. Benedict, who was promoted several months ago to assistant general supervisor of production, transmission and construction for the company.

Arthur L. Crawley and John R. Thomson are advancing from positions as assistant managers to managers, the former succeeding F. A. Beard at Flint and the latter Samuel Ball at Bay City. Mr. Beard has retired after 46 years of service and Mr. Ball after 42 years of service with the company.

David H. Gerhard has transferred from the Alma division to Saginaw, succeeding Fred C. Cope who has resigned because of ill health. Herbert L. Ziegenhein is advanced to division manager at Alma to succeed Mr. Gerhard.

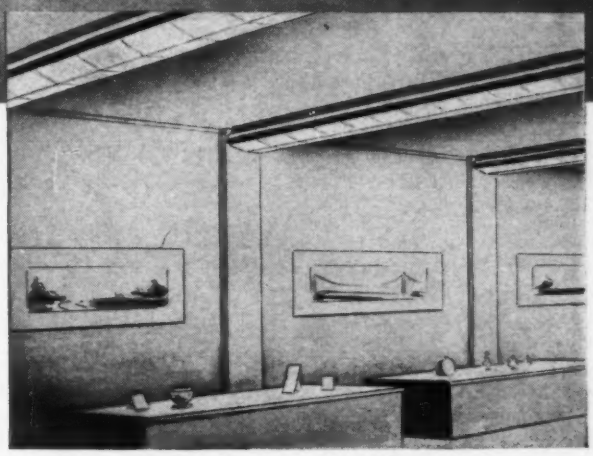
George F. Stecker has retired after being associated with Consumers through almost its entire history. His service record covered more than 56 years. Arthur R. Hamilton succeeds Mr. Stecker as general superintendent of construction of electric plants and substations.

•

▶ STANLEY FARIS, manager of the Illinois Rural Electric Co., at Winchester, has been made president of the Illinois Electric Cooperative Managers Association.

▶ CHESTER F. BUCKLEY, manager of the Taunton (Mass.) municipal electric light department since 1932 and a past-president of the Municipal Lighting Association of Massachusetts, has resigned as of October 1, 1946, to become works manager of the Taunton division of the National Silver Co. Mr. Buckley will spend a limited portion of his time for the next half year as a consultant to the city's electric light commission. He was born in Taunton and was graduated from the Massachusetts Institute of Technology in 1926. For a short time he was connected with the Brooklyn Edison Co., and then returned to Taunton in 1927 as assistant manager of the city's lighting department, succeeding the late George F. Seibel five years

NEW! Holoflux Close-Ceiling Unit...Engineered to Provide Efficient, Economical, Fluorescent Lighting...



✓ **Fully Enclosed**
for economical maintenance

✓ **Smartly Designed**
for modern commercial interiors

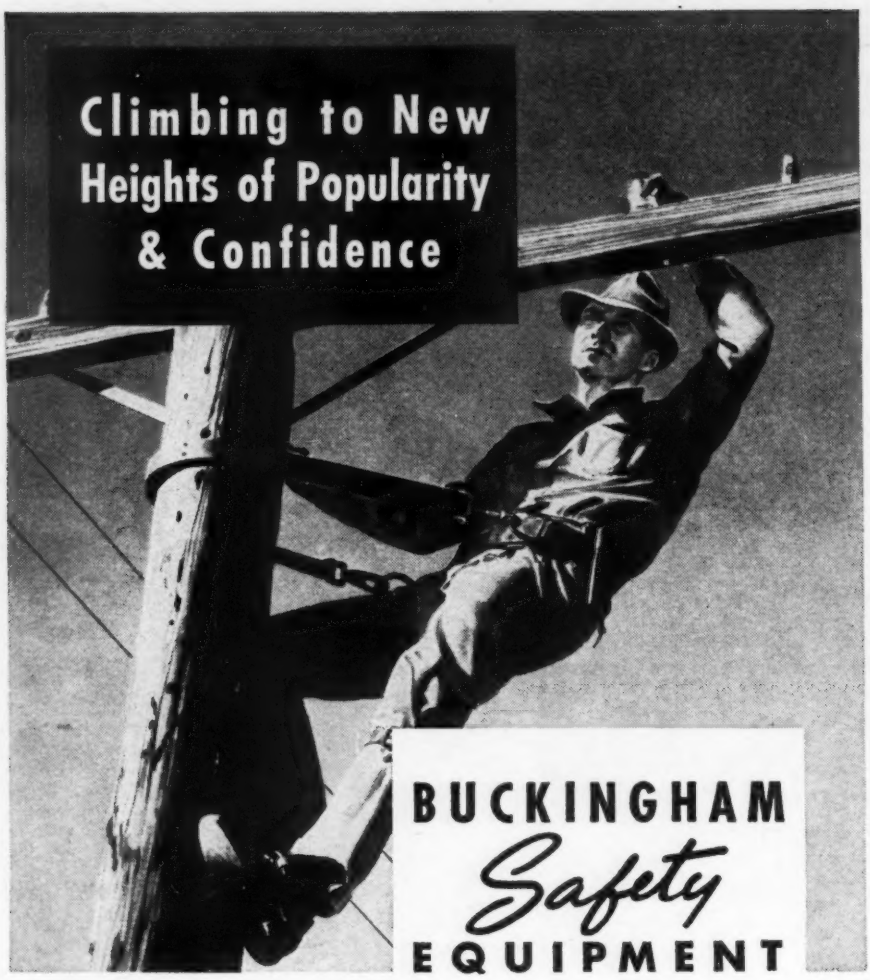
Holophane Engineering Research contributes another important advance in *planned* fluorescent lighting for commercial interiors. This new close-ceiling unit embodies the characteristic advantages of all Holoflux products—the control of down-light by the use of Controlens, increasing illumination in the vital 0-60° zone, reducing glare to a minimum . . . An upper refracting section spreads ceiling light, which reduces contrast between the unit and its background . . . Equally important, the enclosed construction protects it from the collection of dust and dirt, affording marked savings in maintenance costs . . . And this unit is as good-looking as it is practical—its smart, smooth lines should fit gracefully in most interiors.

Illustration shows how Holoflux Close-ceiling Units may be joined to provide continuous lines of light. Units may be dropped on stems to avoid beams, sprinklers, etc. Units take 2, 3, or 4 lamps per section.

Write for Data . . . Consult Holophane Engineers, no Obligation.

HOLOPHANE COMPANY, INC. . . . *Lighting Authorities Since 1898*

342 Madison Avenue, New York 17 • Holophane Co., Ltd., 383 Yonge St., Toronto, Can.



For 45 years, Buckingham safety equipment has guarded the linesman's life and limb from accident and carelessness. For 45 years, it has kept him *comfortable* as well as safe.

That's why today Buckingham equipment enjoys demand and popular confidence never before equalled in Buckingham history . . . why expanded Buckingham facilities are turning out more safety equipment than in any previous year.

Stephens Climbers

Exclusively manufactured by Buckingham for 45 years, the Stephens Climber is world-famous for its quality and safety features.

★ With production up 50% — and still going higher — opportunity for Buckingham distributors is improving every day. If you're a qualified distributor in open territory . . . if you want a reputable line upon which you can build solidly for the future . . . write today for complete details.

Buckingham Easy Belt No. 58

Safe and comfortable, it's made of tan harness leather, lined with soft chrome lace-leather. No metal contact with the body. Forged Dee-ring and buckles are individually tested.

Write for Catalogue 24 showing the complete Buckingham line.

Buckingham MANUFACTURING CO., INC.

Walter E. Craw, President **5-7 Travis Street, Binghamton, N. Y.**

later. Under his administration the department has become free of debt and the generating plant and distribution system expanded and developed along highly efficient lines, with noteworthy work in the fields of public and industry relations.

•

Promotions Made by N.Y. Utility; Goudey Retires

William B. Goudey, who has completed 28 years' service with the New York State Electric & Gas Corp., will retire this fall as vice-president and Binghamton division manager. In accepting Mr. Goudey's retirement, R. D. Jennison, president of the company, announced a series of managerial and other promotions. William H. McElwain, Elmira division manager, will become Binghamton division manager. Homer H. Chapman, eastern division manager, will succeed Mr. McElwain. David A. Lewis, operating superintendent of the western division, will become eastern division manager. Jack S. McMullen, operating superintendent of the Perry-Hornell district, will succeed Mr. Lewis.

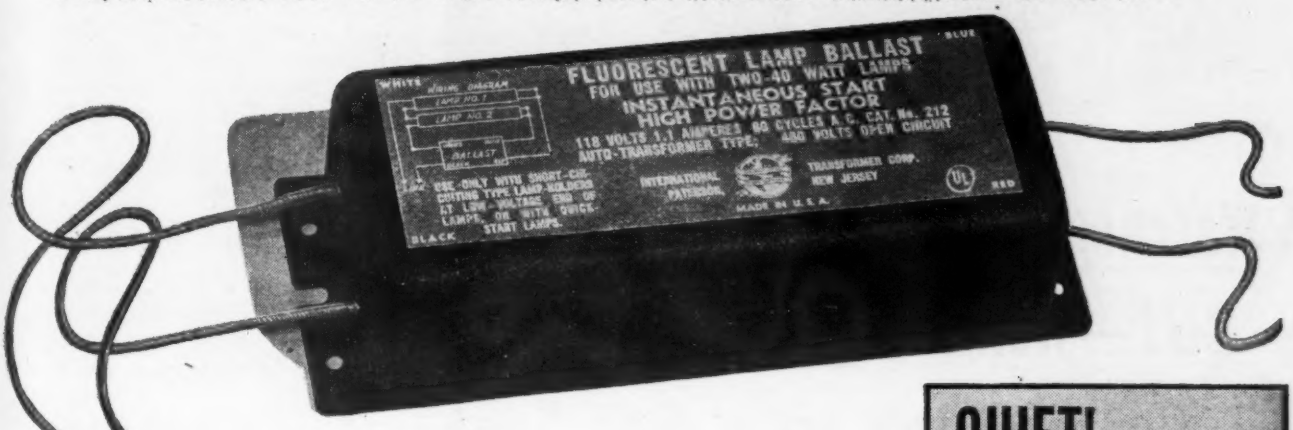
Mr. Goudey, whose career in the electrical field began 48 years ago, became operating superintendent of the Binghamton Light, Heat & Power Co. in 1918. Appointed vice-president and general manager of the Binghamton Light, Heat & Power Co. in 1925, he subsequently became manager of the enlarged Binghamton Division of the New York State Electric & Gas Corp. He was elected vice-president in 1940. Mr. McElwain entered the company's employ in 1926 and Mr. Chapman in 1925. Affiliating himself with the company in 1925, Mr. Lewis was named operating superintendent of the western division in 1941. Mr. McMullen became identified with the utility in 1931.

•

▶ JACOB G. SCHENCK has been appointed design engineer for the Jasper Blackburn Products Corp., St. Louis, Mo. Mr. Schenck was previously connected in a similar capacity with the Emerson Electric Manufacturing Co. and Bussmann Manufacturing Co., both of St. Louis.

▶ W. W. WATTS has been elected vice-president in charge of the engineering products department of the RCA Victor Division. Mr. Watts succeeds MEADE BRUNET, newly appointed managing director of the RCA International Division with offices in New York. Mr. Watts joined the RCA Victor Division last February as general sales manager after serving in the war as Commanding Officer of the Signal Corps distribution

INTERNATIONAL *Precision-Proved* BALLASTS = PERFECTION



The INTERNATIONAL
Double-40 Watt
Instant Start Transformer

Acclaimed the most practical and finest operating unit ever to reach the trade, INTERNATIONAL'S new Double-40 Watt Instant Start Transformer has an abundance of features. Small and distinctive in style, the unit can be used with standard bodies, has minimum hum and practically operates on unity power factor.

There are no starting misses and stroboscopic effects are minimized. The unit is electrically and mechanically perfect, insuring longer bulb life. It is fully guaranteed for one year.

Starters, starter sockets or switches are eliminated. And remember, only this unit permits lighting of one tube even though the other is dead! Order INTERNATIONAL Double-40 Watt Instant Start Transformer today!

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Inquiries Will Receive Prompt Attention.

QUIET!
DEPENDABLE!
CLEAN!
SIMPLE TO MOUNT!
PRECISION MADE!
PRECISION TESTED!

UL Every INTERNATIONAL Ballast approved by Underwriters Laboratories Inc.

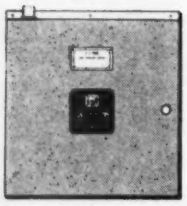
INTERNATIONAL TRANSFORMERS

WHERE PERFECTION IS THE GOAL, INTERNATIONAL IS THE TRANSFORMER.

INTERNATIONAL *Transformer Corp.*

27 KENTUCKY AVE., PATERSON 3, N. J. • 17 WHITE ST., NEW YORK 13, N. Y.

A Watchman that Breathes and Sees *BUT*—Neither Sleeps nor Moves an Inch from One Spot

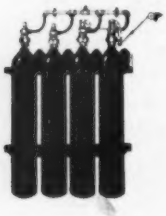


Since men are only human, and some fire equipment is actuated by men after the fire is discovered, it's mighty important that fire is detected when it begins to smolder or smoke. That's the vital job of the combined C-O-Two automatic smoke detecting and fire extinguishing system.

If you store valuable records, tracings or other materials in vaults or isolated spaces you should install C-O-Two. Smoke in a protected space is detected by the new C-O-Two industrial Smoke Detector. It is not dependent upon heat, and the fire is discovered in its incipiency, as smoke alone actuates the detector. The alarm sounds, pressure-operated releases automatically close windows, doors or dampers and a pressure-operated switch shuts off motors to stop ventilation. A time delay controls the discharge of dry, non-damaging, sub-zero carbon dioxide into the occupied area. The fire is under control.

For incipient or flash fires in bake ovens, spray booths, drain boards, dip tanks, flammable liquids and electrical machinery C-O-Two portables with the famous Squeez-Grip valve are recommended. Wheeled and hose units kill fires in seconds. All employ carbon dioxide, the fastest non-damaging extinguishing agent. C-O-Two engineers will help you plan modern fire protection. Write today for information.

C-O-Two is listed by the Underwriters' Laboratories; fully approved by Factory Mutuals and the Bureau of Marine Inspection and Navigation. C-O-Two is a registered trade mark. To be safe, when you buy, specify C-O-Two.



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C-O-TWO FIRE EQUIPMENT COMPANY

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Sales and Service in the Principal Cities of U. S. and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

agency and as a Signal Corps procurement director. Previously he was associated with Montgomery Ward & Co. Mr. Brunet is widely known in the radio industry, and has been associated with RCA since 1921.

•

R. S. Keefer Named Sales Manager of Okonite Co.

R. S. Keefer has been named sales manager of The Okonite Company, Passaic, N. J., to succeed the late Edward J. Garrigan, vice-president in charge of sales.

Formerly assistant sales manager of the company's Hazard Insulated Wire Works Division, Mr. Keefer started his career in the Hazard insulating mill at Wilkes-Barre, Pa., in 1922, later entering the sales department in which he has been active for the past 20 years.

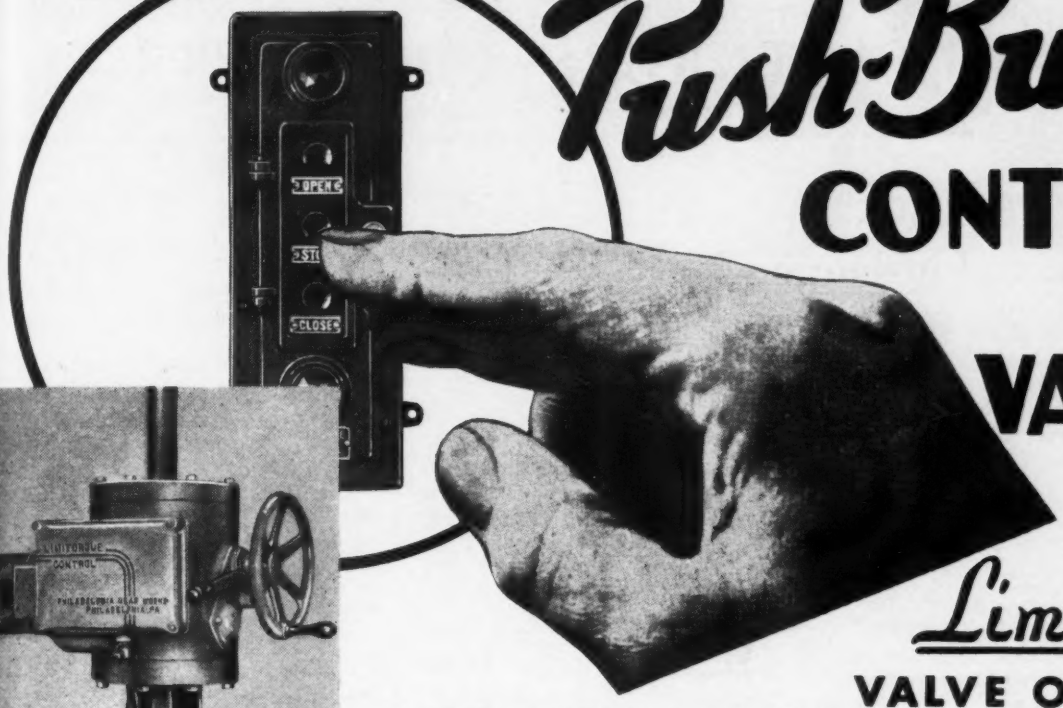
OBITUARY

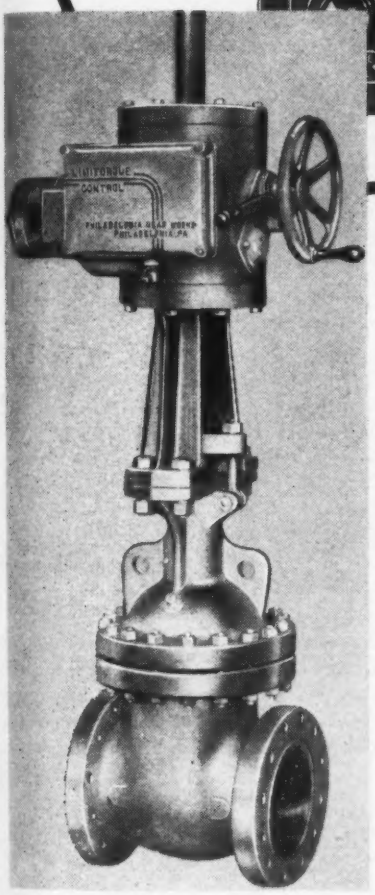
▶GEORGE M. TRIPP, who retired in 1944 as general superintendent for the B. C. Electric Railway Co. at Victoria, B. C., died suddenly at his home in that city recently. Mr. Tripp was 70 years old and had been 46 years with the B. C. Electric organization.

▶FRANK A. PATTISON, retired New York electrical and mechanical engineer, who for half a century was a partner in Pattison Brothers, consulting mechanical and electrical engineering firm, now dissolved, died in Colonia, N. J., on September 18 after a long illness. He was 80 years old. Born in New York, Mr. Pattison was graduated as an electrical and mechanical engineer from Rutgers in 1887. He and his brother, the late Charles Pattison, founded the engineering firm, which did work on many important projects, and continued until 1937, when Frank Pattison retired. Mr. Pattison was a fellow of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers.

▶CHARLES F. WALLACE, 75, former head of the engineering department of Stone & Webster, Boston, Mass., died suddenly at Whitefield, N. H., on September 11. He was graduated from the Massachusetts Institute of Technology in 1892 in electrical engineering, and was connected with Stone & Webster for about 30 years. When Stone & Webster, Inc., was formed he became a vice-president, having been a junior partner in the firm. He was identified with the Keokuk hydroelectric development on the Mississippi River and many other undertakings in the utility field.

Push-Button CONTROL OF VALVES WITH Limitorque VALVE OPERATOR





The "Limitorque" (at left) is for valves working at low to medium temperatures, low to high pressures, and normal speed of operation.

This Unit is mounted on top of valve yoke . . . no extra gears, nuts or bearings required. Stem nut is inside and furnished with Unit. Nut is directly inside worm gear which drives it. (All clutches and connecting sleeves are eliminated.)

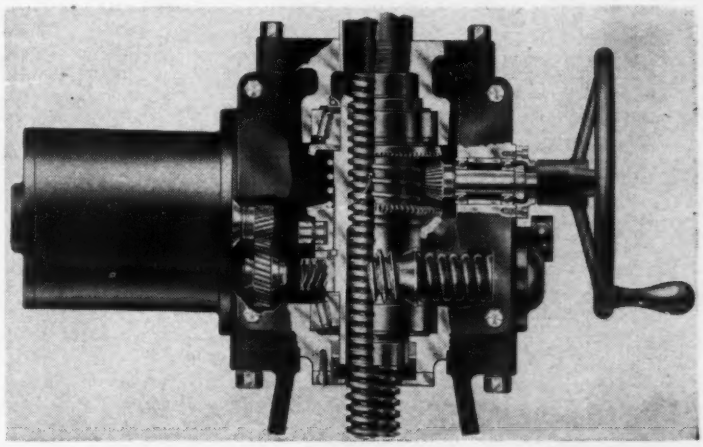
Limitorque is designed for plug, cock, gate and globe valves. . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts, without disturbing wiring.

A special high starting torque motor, reduction gears, limit switches all in one weatherproof assembly, — and all electrical connections are made to one terminal board, easily accessible by removal of watertight cover. . . . Heat treated helical gears and hardened, ground and polished worm and bronze worm gear are used.

A handwheel is provided for manual operation and does not revolve during motor operation. During hand operation motor is mechanically disengaged. Limitorque is always operative electrically. No danger to operator should he be turning handwheel when motor is started, since automatic clutch disengages handwheel instantly, without shock. Declutch lever changes from motor to hand operation. The usual Limitorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.

Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided, because motor is shut off by thrust exerted on valve disc. Valve is protected during entire closing operation.

The Word "Limitorque" has a definite meaning because an exclusive patented Torque Switch actually limits the torque applied to the operating parts.



FEATURES OF THE "SM" TYPE LIMITORQUE

1. Micrometer torque seating switch.
2. Self-contained unit — no gears, nut or bearings to buy.
3. Weatherproof, dust-tight and watertight construction.
4. Hammerblow device.
5. Non-rotating handwheel built into the unit.
6. Automatic declutching.
7. One terminal board for all electrical connections.
8. High torque motors.
9. Simple valve yoke.

Motor is coupled to worm shaft through helical gears. In closing, worm drives worm gear until lugs on the gear meet matching lugs on clutch. Torque is transmitted to the nut through splines connecting the clutch to stem nut. Torque spring is then compressed by axial movement of worm on worm shaft. When torque spring has been compressed to predetermined setting, torque switch is actuated by a tripping collar on worm shaft. This interrupts current to holding coil of controller and stops motor. Inertia of motor is absorbed in further compression of the torque spring. Opening travel is governed by geared limit switch.

Philadelphia GEAR WORKS INCORPORATED

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

MANUFACTURERS & MARKETS

Allis-Chalmers Pittsburgh Plant Settles; First Break in Six Months' Strike

First break in the prolonged strike in the Allis-Chalmers Mfg. Co. plants occurred last week (September 16) when the company concluded an agreement with the C.I.O. United Electrical Workers, Local 613, at its Pittsburgh works. The settlement, generally following terms offered in a company proposal, left six of the company's other plants still strikebound, although back-to-work movements have been growing steadily in half of these.

After 178 days on strike, workers at the Pittsburgh plant, which principally manufactures electrical distribution equipment, voted approximately 4 to 1 to accept the company's long-standing offer of a 13½ cents an hour wage increase, making a total increase of 18½ cents since V-J Day. No maintenance of membership clause or any other form of compulsory unionism is contained in the agreement negotiated by Allis-Chalmers representatives with a new union bargaining committee formed shortly before the settlement.

The new Pittsburgh contract runs until April, 1948, and may be reopened on wages after April 15 next year. However, with the acceptance of a company proposal for government-supervised strike votes, the union can call for a strike in support of its wage demands only after a majority of the employees votes for such a strike in a referendum held on company premises at company expense under the supervision of the NLRB or the U. S. Conciliation Service.

Other Contract Provisions

Other provisions in the contract include irrevocable voluntary checkoff of union dues and assessments, rather than the continuance of maintenance of membership asked for by the union, and an increased arbitration setup covering such issues as equal pay for equal work, new job classifications, disciplinary measures and seniority preferences. The company waived a prior service requirement of its vacation plan, offering to distribute vacation checks to Pittsburgh workers immediately.

In a telegram to Pittsburgh works employees, company and union officials, Walter Geist, company president, expressed a desire for future harmony between company and union, which should be based on recognition of mutual responsibilities.

His message pointed out that "the successful and satisfactory conclusion of this agreement between the company's negotiating committee and the new bargaining committee for the union is a testimonial of the fact that when reasonable men sit down to discuss their differences with sincerity of purpose moved only by a desire to deal fairly and to reach an agreement as early as possible, it can be done. The overwhelming support the union members gave their new bargaining committee speaks well for their faith in that leadership."

ALL-STEEL frame motors, known as the Life-Line motors, on the finishing line at the Buffalo plant of Westinghouse Electric Corp., are being tagged for shipment

•

Power Cable Engineers Publish Inclusive "Specs"

The "General Specifications for Wire & Cable with Rubber and Rubber-Like Insulations for the Transmission and Distribution of Electrical Energy" has been completed and published by the Insulated Power Cable Engineers Association, 283 Valley Road, Montclair, N. J.

Specifications consist of two main divisions: the first composed of eight parts covering general constructional data and test procedures common to most cables, and the second, composed of a series of appendices which include requirements for various grades of rubber and rubber like material insulation and sheathes, and also a complete table of values of log D/d for use in calculating insulation resistance values.

These specifications have been in preparation for several years and provide the consumer with the means of securing a covered conductor suitable for the bulk of requirements by use of a single specification.

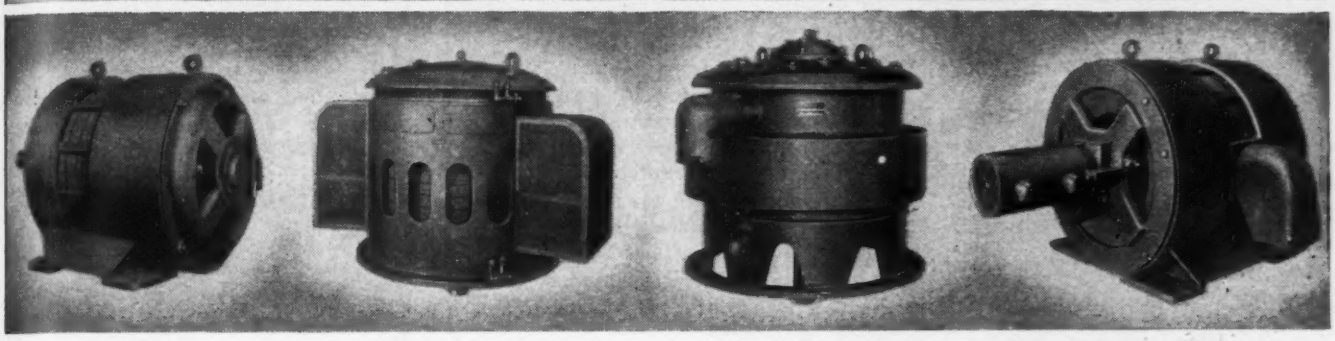
•

Combine Sales-Service Units

Consolidation of sales development and engineering service divisions of Allegheny Ludlum Steel Corp. under the managership of W. B. Pierce has been announced. Functions of the new department will be to coordinate and ex-

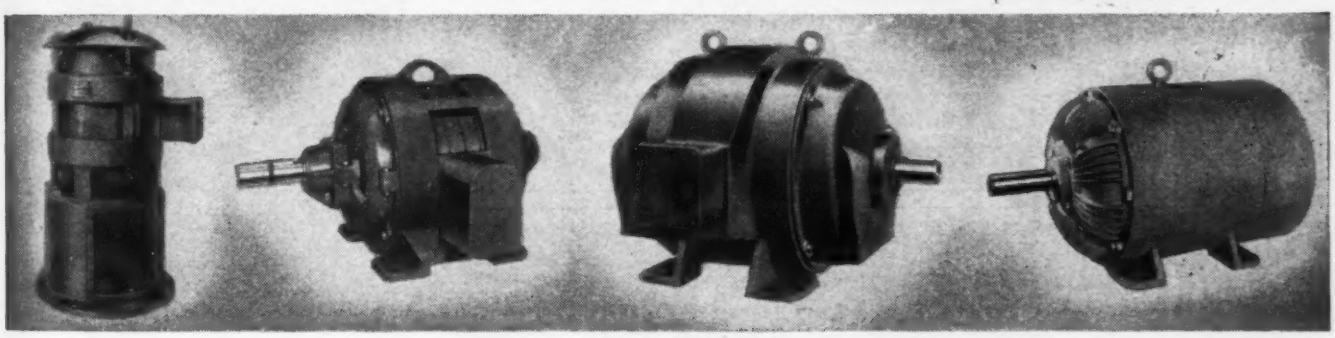
THERE'S ONE CORRECT INDUCTION MOTOR

• *that best fits into your plant*



200 Hp. Induction Motor | 400 Hp. Vertical Ind. Motor | 200 Hp. Squirrel Cage Vertical Ind. Motor | 300 Hp. 4-Speed Squirrel Cage Ind. Motor

25 Hp. Vertical Ind. Motor | 250 Hp., 1800 r.p.m. Ind. Motor | 30 Hp. Splash-proof Ind. Motor | 40 Hp. Fan Cooled Ind. Motor



BURKE INDUCTION MOTORS assume all kinds of types and sizes to meet specific conditions. They may be *Squirrel Cage*, with normal torque—normal starting current; normal torque, low starting current; high torque, low starting current or high torque, high slip. They may be *Wound Rotor* with constant or varying speed.

They may be multi-speed, drip and splash-proof, enclosed, enclosed fan cooled, vertical, flange, round frame and in sizes from 1 to 1500 H. P.

Consult with Burke engineers for that correct high quality induction motor *designed for the job.*

For a description of the complete Burke line of AC and DC motors and generators, consult Sweet's Engineering catalogs or Electrical Buyers Reference catalog.

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Phone: Raymond 8241

L. B. RITCHIE
Room 1704, 274 Madison Ave., New York, N. Y.
Phone: Lexington 2-5330

B. A. AUERBACH
Room 234, 1600 Arch Street, Philadelphia, Penna.,
Phone: Rittenhouse 5226

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BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

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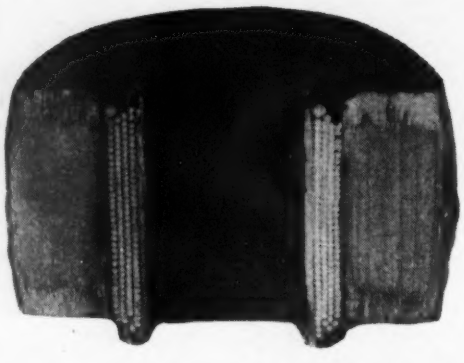
Acme
ELECTRICAL INSULATING VARNISHES



Acme Wire Co., pioneer and specialist in magnet wire, coils, insulations and varnishes, now makes generally available the insulating varnishes which Acme engineers have developed during years of intensive research and actual production in the Acme coil winding plant. These thermosetting and oxidizing varnishes will enable you to attain the highest known insulating standards. Send for our new catalog.

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VARNISHED INSULATIONS, MAGNET WIRE, COILS

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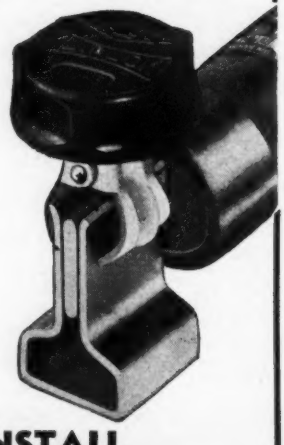
CLAMPS FOR FUSE CLIPS

SAVE FUSES-CLIPS-POWER!

Note how that jack-screw pressure bolts the fuse and clip together!



KLIPLOKS ELIMINATE

- Destroying temperatures
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End your troubles TODAY! Install KLIPLOKS everywhere—on old and new clips. Be sure to say: "TRICO KLIPLOKS—nothing else will do." There's a size to fit both ferrule and knife blade types fuse clips. Write for Bulletin Number 6!

TEST CLAMPS

A sturdy clamp that carries heavy currents and "stays put" when attached. Made in 7 sizes 0-300 amps.

INSTALL KLIPOK CLAMPS TODAY!

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

tend the company's cooperation with users and fabricators of stainless steel on their problems of applications and uses. Special attention will be given to the development of new markets for the introduction of new alloys. Formerly manager of the organization's sales development division, Mr. Pierce joined the company in 1945 after war work with the War Production Board.

•

Stevens Manufacturing Co. Organized in Mansfield

Formation of the Stevens Manufacturing Co. to engage in the design, manufacture and sale of electrical ap-

pliance and industrial thermostats has been announced by W. C. Stevens, president.

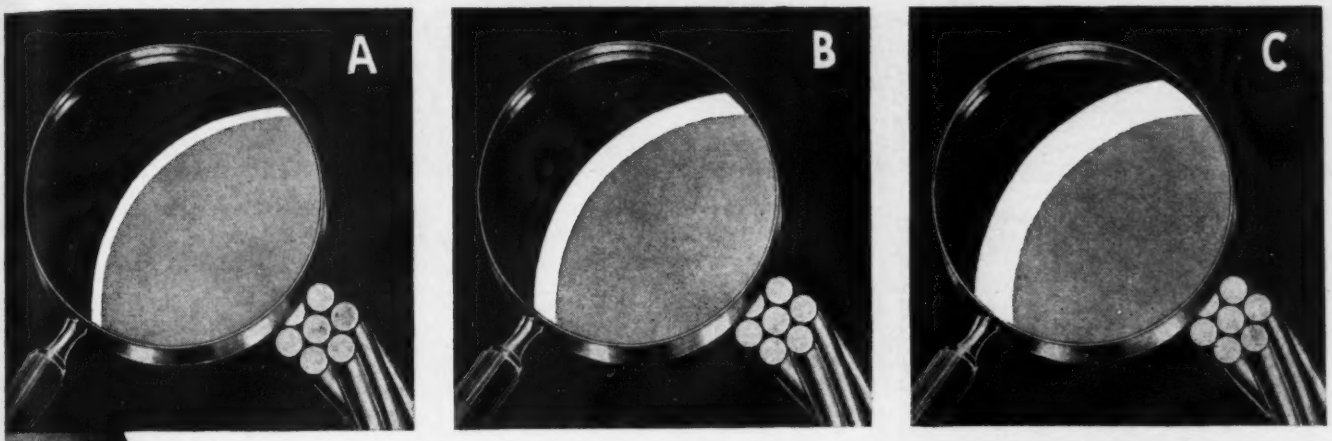
The company's plant is in Mansfield, Ohio, and sales offices are in the Richland Trust Building in that city. Large scale production is now under way on several thermostat models for ironers, water tanks, radios, sterilizers, etc., according to Mr. Stevens. Other models will be soon announced.

Prior to organizing his own company, Mr. Stevens was affiliated with the Westinghouse Electric Corp. for 21 years. At the time of his resignation, he was manager of thermostat sales.

•

Elliott Omits Dividend

Directors of the Elliott Co. took no action last week on a dividend on the common stock usually due at this time. W. A. Elliott, president, announced that the dividend was not declared "because of higher labor and material costs on contracts in process, material shortages causing reduced shipments, and losses incurred during the two months' strike early this year." The regular quarterly dividend was declared on the preferred, payable on October 1.



A, B, OR C COATING . . .

Which?

When analyzing his requirements, every purchaser of bethanized strand has three coating-weights from which to choose—A, B, and C. The B weight is twice as heavy as A; the C weight three times as heavy as A.

Before making his choice, the user naturally considers corrosive conditions in the area where the strand is to be used. He knows, of course, that the A coating is entirely suitable in many localities. But, when corrosive action is very severe, or where extra protection is required for other reasons, the heavier B or C coating-weight is generally specified.

It's something like war. Maybe a crack unit is overwhelmed by enemy numbers. When this happens, stronger defensive forces are called for.

In the case of bethanized strand, zinc-coated by Bethlehem's exclusive electrolytic process, you can bring up your reinforcements in advance. For average inland rural conditions, the A-weight coating will do a fine job for you at a remarkably low cost. But where excessive moisture, salt air, smoke, or acid fumes attack your strand—or get together to gang up on it—you'll probably need the heavier B or C. Under such conditions, B or C will prove the most economical in the long run, when you consider the extra protection afforded.

Whatever your requirements, you are assured of a long-lived coating when you buy your strand from Bethlehem. The zinc armor is of high purity, and the bethanizing process virtually eliminates flaking, peeling, and checking. Ask for complete details.

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Why it will pay you to try

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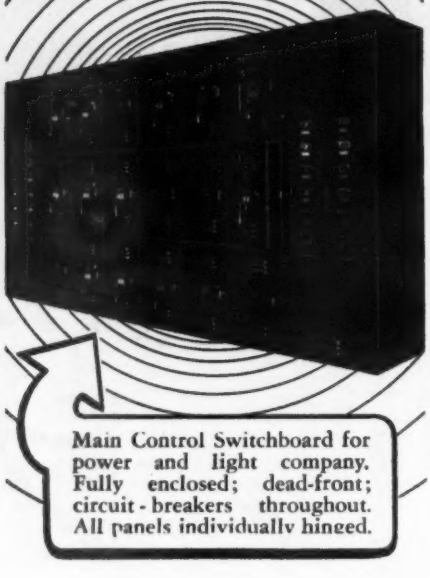
for your next Switchboard



Main Control Switchboard for power and light company. Fully enclosed; dead-front; circuit-breakers throughout. All panels individually hinged.

1. Exceptional Engineering Service. The wide experience of our Engineering Department has included the most difficult problems of switchboard design. We can send an engineer to combine our experience with yours in planning a job.

2. Highest Standards. The wide preference for Pelham Switchboards is largely due to the knowledge of electrical engineers that "Pelham" on a board definitely guarantees the best of materials and workmanship.

3. Unusual Cooperation. We take full responsibility for meeting all specifications of architects and engineers, as well as municipal, state, or federal requirements. Our deliveries are made when promised.

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Erie, Pa.

SPECIALIZED DESIGN
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UNEXCELLED QUALITY
SWITCHBOARDS · PANEL BOARDS
SWITCH GEAR AND ACCESSORIES

FIELD REPORTS ON BUSINESS

Inquiries for electrical equipment are holding at a high steady level. Quotations for deliveries, however, continue to lengthen out. Lighting activity is an outstanding feature of the electrical scene. Minor appliances are becoming more plentiful.

NEW YORK

OPA stated last week that it was not contemplating "in the foreseeable future" any increase in the present ceiling prices of primary and secondary copper, copper scrap, copper base alloy scrap or brass mill scrap. The action was taken, it was said, to eliminate pricing uncertainties and to discourage anticipatory withholding in expectation of price advances.

Estimated expenditures in plans for new buildings, and for alterations and repairs to existing structures in New York City rose by $24,000,000 from June to July, according to Industrial Commissioner Edward Corsi, head of the New York State Department of Labor. The increase followed a sharp drop in June.

Wage rises in manufacturing industries between the end of the war and May, 1946, averaged about 14½ cents an hour, the Bureau of Labor Statistics reported. When all workers are considered, including those not affected by general wage changes, the average gain amounted to about 11½ cents, the agency reported.

That the decline in security prices has affected dissolution plans of public utility holding companies was further indicated when Consumers Power Co., subsidiary of Commonwealth & Southern Corp., announced that date for opening of bids on sale of Consumers common stock had been postponed indefinitely.

CHICAGO

Electrical experts here believe the city's code should provide for increased use of copper to meet rising appliance loads. In multiple residences, for example, heavier service wires should be employed and there should be an outlet every 12, instead of every 20 lineal feet, as at present. Current furnished should be 2 watts per sq. ft. of capacity, and there should be no branch circuits beyond 50 ft. from load centers, thus keeping load centers in or near the apartments and avoiding long line drops to secure current. It is also thought advisable to change the diversity factors on ranges, as a result of experimental work done here. In industrial installations, it is suggested that there be not more than three cables per leg.

Webster Electric Co., Racine, Wis., has switched to new products in the course of reconversion, including a thermally controlled drive for the motor used with fans in warm-air furnace or air-conditioning systems. The firm has also developed an ignition transformer which ignites automatically and electrically the atomized oil at the nozzle of the conventional oil burner. A new type of freezer has been developed by Ben Bar Sales, Inc., Milwaukee, featuring an alarm system that informs the owner of power failure or blown fuse so the trouble can be corrected before the food thaws.

Electric Supply Corp. has added a conduit warehouse to its present building and enlarged its fixture display room. Capitol Electrical Supply has purchased a new building for added warehouse space. Horton Mfg. Co., Ft. Wayne, Ind., has developed a small table-model mangle with a roll 22 in. long.

PACIFIC COAST

Total value of August building permits for the seven western states was $81,040,585, an increase of 5 percent over July and nearly three times the figure for August last year with Arizona and Washington considerably exceeding these gains.

Bryant Electric Co. will move its Pacific Coast warehouse of wiring material from San Francisco to Los Angeles and will hereafter be represented in the Northwest and Bay region by sales representatives.

Density of electrical construction demand is a factor as Los Angeles city and county accounted for half of California's August building permit total of $64,968,653, which in turn was 80 percent of the seven western states. Mounting volume of building construction has caused CPA to withhold approval on structures hitherto considered essential, such as grammar schools, in order to maintain the percentages requested of it last May.

Shipments of electrical material from wholesalers' factories are steadily improving and although much construction all along the coast in various stages of completion is being delayed by lack of various building essentials these are seldom electrical.

Pacific Gas & Electric Co. is building 110 miles of transmission line in comparatively virgin territory in northwestern California through Shasta and Humboldt Counties from Anderson to Freshwater. This initial work and substations in a future network comparable to other farming districts in its system will cost $2,237,500.

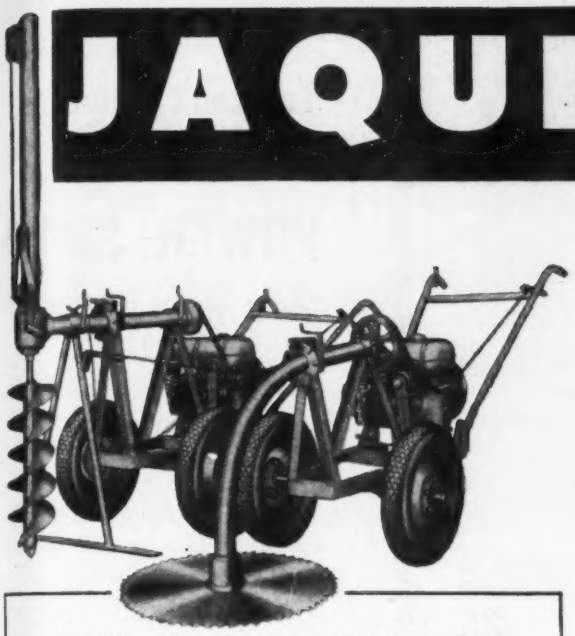
NEW ENGLAND

Industrial output in this area is climbing and inquiries for electrical equipment are holding at a high steady level, although quotations for deliveries continue to lengthen out. Activity in Massachusetts metal products lines is stepping up. Bangor Hydro-Electric is constructing more transmission line facilities to serve increased loads in the Millinocket (Me.) area and outdoor crews are expected to complete at least 100 miles of rural line this year.

Boston is planning on a replacement of 4,800 gas lights by electric lights during the next five-year period and has installed a dozen units in the Brighton district.

Inquiries for electric pumping equipment are strong. Last week approval for the preparation of plans for two new pumping units estimated to cost about $900,000 was granted to FWA. Electrically heated blankets are available in the Boston retail market, and some minor appliances are more plentiful. Bangor Hydro-Electric reports appliance sales for the first half of 1946 at $107,710 compared with $26,071 for the corresponding period in 1945 and notes that deliveries in that section of New England are slowly improving.

JAQUES LABOR SAVING MACHINES



Do the Job
QUICKER • BETTER

If it's a big job like constructing a telephone, power line, or drilling foundation holes, THE JAQUES HYDRAULICALLY CONTROLLED EARTH BORING MACHINE below will do the job faster, easier, and better—at a saving in time, manpower, and cost. Note some of its principal features:

1. ALL PLUMBING is hydraulically controlled, enabling faster operation and transportation from hole to hole as machine can be instantly lowered to traveling position, and again quickly placed in operating position regardless of the unevenness of the terrain.
2. FASTER DRILLING, as the hydraulic feed maintains a constant pressure on the bit maintaining the maximum R.P.M.'s on the auger without the slipping of any clutch or gears. The texture of soil controls the rate of digging.
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4. HYDRAULIC FINGERTIP CONTROL reduces operator fatigue to a minimum.
5. ONE MAN easily operates this machine as all controls are conveniently located.
6. PEAK OPERATING maintained hour after hour with these simple trouble-free hydraulic controls.
7. HOLES CAN EASILY be drilled at any angle.

ENGINE—Industrial Type Gasoline, approximately 30 h.p. S.A.E. Rating, with starter, generator, and battery. UNIT—mounted on steel-I-beam skids (Easily attached to or removed from truck or other conveyance). DRIVE—MECHANICAL—four forward speeds and one reverse. FEED—HYDRAULIC. LIFT—HYDRAULIC. LEVELING—HYDRAULIC. HOLE SIZE—Up to and including 24 inches. (Larger diameter on special order). DEPTH OF HOLE—8 to 9 feet with standard machine (greater depth on special order). WEIGHT—Approximately 3900 pounds. WIDTH—4 feet, 3 inches; LENGTH—10 feet

JAQUES JR. POST-HOLE DIGGER

HOLE DIGGING is easy, fast, economical and efficient with the JAQUES JUNIOR POST-HOLE DIGGER. In ordinary ground, it bores 9" hole three feet deep in sixty seconds or less. Can be operated by one man. Throws dirt out leaving hole clean. Complete, F.O.B., Denison . . .

$398.00

JAQUES JR. PORTABLE POWER SAW

It's easy to clear land of brush and trees, with a JAQUES JUNIOR PORTABLE POWER SAW. Its 30" unbreakable saw, powered by 5 to 6 h.p. engine zips through brush and trees in seconds, cutting them off level with ground. Once tree is felled, angle of saw can be changed quickly to trim and cut tree to any desired length. Price of saw, complete, F.O.B., Denison, is only . . .

$379.50

SAVE $200 ON COMBINATION

If you prefer, you can buy the SAW complete with frame and engine for $379.50 and the Post-Hole Digger attachment, which is interchangeable with saw, for $198.00 extra. Switch from Saw to Post-Hole Digger can be made in about five minutes.

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SUPERIOR SWITCHBOARD & DEVICES CO.
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A SUBSIDIARY OF THE UNION METAL MANUFACTURING COMPANY

CPA Sees Production Rise for Electric Lampholders

Production of medium screw base electrical lampholders is expected to meet requirements, including the 1946 order backlog, by the end of 1947, the CPA has advised the Electrical Current-Carrying Wiring Devices Industry Advisory Committee. These production estimates are predicated on adequate flow of raw materials and components and early resolution of remaining price problems, CPA said.

Estimates of 1946 requirements for medium screw base sockets, lampholders and lamp receptacles are 122,000,000, with production estimated at 100,000,000, leaving an estimated deficit of about 18 percent, a representative of CPA's review and analysis staff told the committee.

Minimum requirements for 1947 are estimated at 133,000,000 lampholders, with a production of 170,000,000, leaving an apparent surplus over the two-year period of 15,000,000. Much of this 1947 surplus will be absorbed, however, by unusually large demands by portable lamp manufacturers, CPA stated.

•

Increased Production Units Planned at Westinghouse

A $120,000,000 financing plan to provide for completion of a $132,000,000 plant expansion and rearrangement program and for increased working capital requirements resulting from expected unprecedented peace-time production has been initiated by the Westinghouse Electric Corp. To initiate the plan, the company has filed with the Securities and Exchange Commission two registration statements covering: 1, an issue of 1,647,037 shares of common stock, and 2, an issue of $30,000,000 of debentures.

In announcing the financing plan Gwilym A. Price, company president, pointed out that, as a temporary measure, $80,000,000 was borrowed from banks on May 1 of this year to repay $30,000,000 outstanding in V Loans, and to provide for operating commitments necessary for return to peace-time manufacturing and sales. At least $30,000,000 from the sale of the proposed new common stock will be used to reduce these bank loans, and the balance added to the company's treasury. It is expected, he said that the proposed new preferred stock will refund the balance of the $80,000,000 of bank loans.

He explained that the company's expansion program involves the purchase of additional equipment and plants, construction of additions to existing

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POWER SHOW

More new products this year than ever!

The 1946 Power Show will feature the exhibits of over 350 manufacturers — all presenting the newest developments in power generation, mechanical power transmission, materials handling and associated equipment. Come and study the displays, see the demonstrations. Discuss your problems first-hand with the informed representatives of exhibitors. Learn how you can improve power production and power utilization in your plant.

General public is not admitted. Attendance only by invitation or registration. Bring your staff with you.

17th NATIONAL EXPOSITION of POWER and MECHANICAL ENGINEERING

Grand Central Palace
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Now . . .

Make quicker, more accurate calculations

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NEW, HELPFUL MATHEMATICAL TOOLS

HERE is a practical, easy-to-use book that gives engineers in any field many special mathematical tools basic to their work. It shows how these tools are applied to compute both speedily and reliably. Concise yet complete, this book is valuable for reference or study, covering every phase of mathematics you are likely to meet—from simple numeric computations, through integration and summation. Many of the topics discussed are new, while others which are more commonly used are presented with new applications, thus increasing their usefulness.

Just Published

MATHEMATICAL AIDS FOR ENGINEERS

By **RAYMOND W. DULL**, Consulting Engineer

369 pages, 5¼ x 8¼, $4.50

New equations for the construction of several important types of alignment charts are given for using standard engineering scales which simplify the construction of the charts. The presentation of logarithmic and exponential functions is thorough and should prepare the reader for more advanced applications of mathematics. The exponents of the Naperian base are given special attention. Unusual application of the triangle and circle as mathematical tools will be found in the text, some even involving differential equations. Considerable attention is devoted to vector analysis, and methods are given which simplify the solution of somewhat difficult engineering problems. The introduction of vector images opens a new field for vector application. The book ends with an introduction to differential equations to apply some of the mathematical tools supplied earlier.

Some of the 28 chapters cover:

- logarithms as an implement
- organic decay or dying-out functions
- circles as tools
- imaginary and complex numbers
- energy
- linear motion
- kinetics of rotation
- plane motion
- images
- differential equations of the second order
- linear differential equations of the *n*th order with constant coefficients

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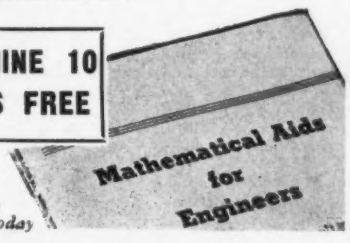

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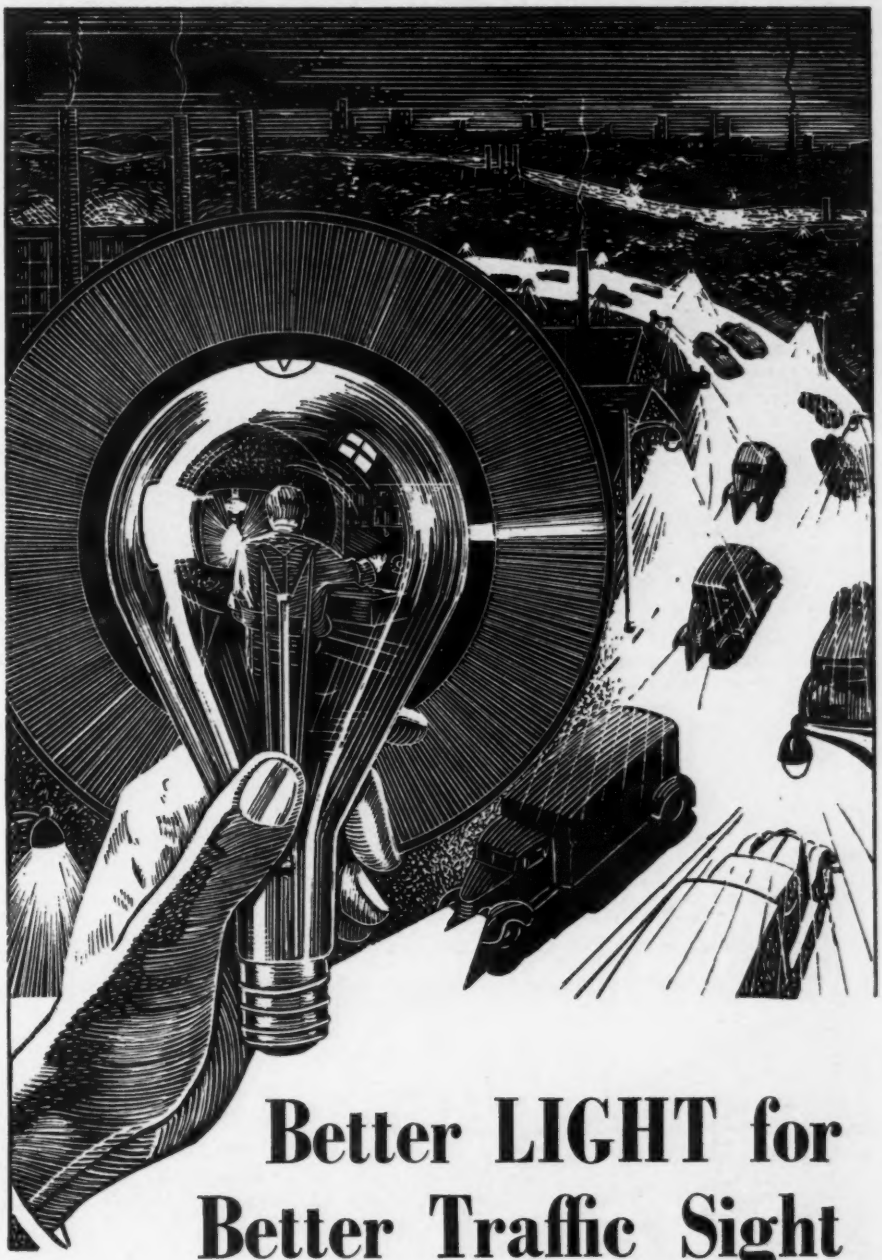

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Years of specialized research have enabled Utility illumination engineers to meet the need for better light. Maximum efficiency of each Utility Lamp plus long life are the result of sound engineering, precision manufacture, and never any compromise with quality. Scores of tests and inspections of each lamp assure unfailing performance for the rated lamp life, under all conditions. The fact that Utility Lamps are used exclusively throughout New York City . . . and in many other large and small municipalities . . . attest to their satisfactory service record in providing better light for better traffic sight.

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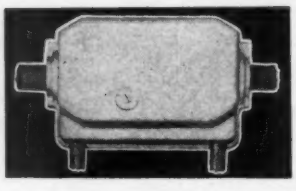
Service Cable Connection Boxes

For permanent or emergency housing. A ship-shape and economical method of eliminating open wire bus or radial distribution. Heavy marine type construction. Each box accommodates either one or two services.



Cat. CB5

Cat. CB2 for #2 or #4 Main & #6 Drop Cable

Cat. CB5 for #4, #6, or #8 Main & #8 Door Cable

4 Cat. CB5 Serving 6 dwellings Can be continued from block to block

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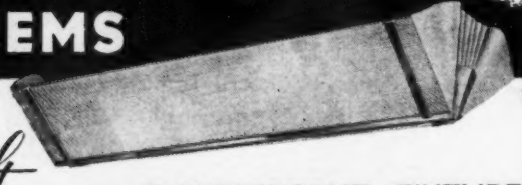

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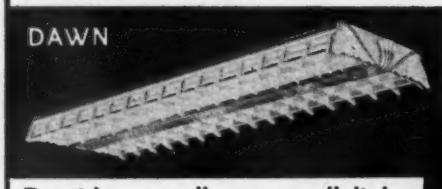

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Provides excellent overall light with beauty of design and economy of open type unit.

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A complete line of commercial and industrial fixtures

Smithcraft LIGHTING DIVISION, CHELSEA 50, MASS.

plants, and the integration and rearrangement of these expanded facilities to meet the greatest expected volume of peace-time sales in the company's 60-year history. Pre-war volume of production will be greatly increased, he said, by the development of new products and the addition of new items to established lines.

"Of the $132,000,000 program, approximately $95,000,000 represents the cost of new facilities and equipment, and the balance the cost of rearrangements and related expense," Mr. Price said. "Up to May 1, 1946, approximately $35,000,000 had been expended in connection with the expansion and rearrangement program, and we have allocated an additional $46,000,000 to be spent before the end of this year, and approximately $51,000,000 thereafter.

"These new facilities," he added, "will provide the company by 1948 with the capacity to more than double its pre-war production."

•

General Electric Cable Plant Closed by Lead Shortage

General Electric Co. reported this week that its cable plant at the Schenectady Works had been closed down for a week and faced the prospect of a shutdown of several weeks because of an exhausted lead supply.

Pointing out that the entire company's lead quota for the third quarter has been consumed, Roy C. Muir, General Electric vice-president and general manager of the apparatus department, said that the situation was becoming increasingly critical.

General Electric emphasized that lead-covered cable is badly needed by public utilities to extend service to new housing projects and expanded industrial plants. He said that there was an additional need for the replacement of considerable cable now in use.

Mr. Muir stated that the company is currently receiving two-thirds of its average pre-war requirements. He attributes the current shortage not only to the unusually high world demand, but to government pricing, which is below world price levels, to strikes in the lead industry during the first six months of 1946 and to a continued labor shortage in that industry.

•

General Mills Making Irons

General Mills is in production of its new iron, the first in the company's line of new home appliances. Production began on a small scale in June and was gradually stepped up to the present 1,600 irons per day.

It's YOUR future—Make the most of it!

Start now to earn the bigger pay in electrical repair

Electrical Machinery — Arnett
Connecting Induction Motors — Dudley
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5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings— to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

Includes trouble-shooting book

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

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We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

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27-5-40	22⅞ in.	20 watt	12

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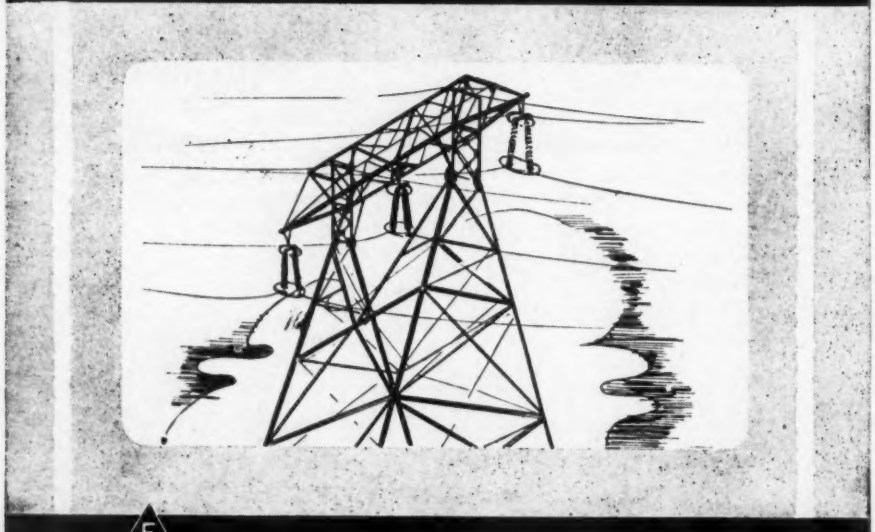

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Recent Rate Changes

PORTLAND GENERAL ELECTRIC CO., Portland, Ore., will put into effect on October 23 a new electric rate schedule, which, coupled with a rate reduction by the Northwestern Electric Co., will bring to the Portland, Vancouver and northern Willamette Valley area rates which have been cut to the amount of $505,000 annually, based on present use. The latest reduction, applying to both Portland General Electric territory from Portland to Salem and Northwestern Electric in Portland and the Vancouver areas, were announced by George Flagg, Oregon Public Utilities Commissioner. In the residential group the new schedule will give substantial reduction to those not eligible for last April's "all-electric" rate, which requires bulk use with an electric range and water heater as a minimum. On Portland General Electric lines the savings will be $345,000 based on 1946 use and more if demand continues to grow, company officials estimated. T. E. Roach, vice-president and general manager of Northwestern, stated it will cut the cost of 100 kw.-hr. in city homes by 5 percent and farm homes 8 percent. Commercial rates will be cut an average of 5 percent. Annual savings to Northwestern customers will be about $42,000 for residential, $80,000 for commercial, $22,000 for rural and $16,000 for industrial. P.G.E. residential reductions will equal $170,000 annually; commercial saving will be $135,000 annually and large industrial users will save $40,000.

SIERRA PACIFIC POWER CO., Reno, Nev., has announced a new rate schedule which will result in annual savings to customers of approximately $103,000. Increased business of the company was given as the reason for its being able to make the reductions. In the Reno-Sparks area, largest served by the private utility, reductions of 6.7 percent for residential and 5.9 for commercial users are now in effect, while other communities benefitted by Sierra Pacific's action by as much as 33 percent. Domestic and commercial schedules had been lowered by the company in the Lake Tahoe area on May 1.

IOWA SOUTHERN UTILITIES CO. has reduced residential and commercial electric rates in Creston, Iowa. The reduction will mean an annual average saving of $2.80 to each of the company's 50 000 users, District Manager Charles E. Fiers stated. Estimated total saving on present electrical consumption will be $140,000. The new rates are in effect for September on bills payable in October.

CITIZENS UTILITY POWER CO., Wallace, Idaho, has filed with the Idaho Public Utilities Commission reduced commercial rates that will reportedly save consumers over $7,000 annually. John W. Cornell, chairman of the utility, said the rate reduction was made at the request of the commission. The new rates, which will affect commercial users only, will be effective in Wallace, Mullan and Burke, all in Idaho.

GRAND ISLAND, NEB., has announced a reduction in electric service rates. The city recently took over properties of the Consumers Public Power District at Grand Island and St. Libory, suburb. Residence lighting rates of 3.7 cents for the first 50 kw.-hr. are reduced to 1.3 cents for all over 100 kw.-hr. Commercial lighting rates range from 3.7 for the first 100 kw.-hr. down to 1.3 for all over 1,500 kw.-hr. New power rates of 3.7 cents for the first 100 kw.-hr. drop to 1.3 cents for all over 20,000 kw.-hr.

Star Performance!

There is but one true measure of the value of a water heater and that is, performance—plenty of hot water, long trouble-free service.

Two exclusive Clark features—Ionodic Tank Protection and Life-Belt Heating Element, enable the Clark Electric Water Heater to give performance unequalled by any other heater on the market.

Judged by performance or any other standard, the Clark today, even more than ever, is the greatest water heater value on the market.

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5201 W. 65th St.
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Combining maximum flexibility with temperature resistance up to 400-425° F... Built to meet or exceed VTA or ASTM specifications or to your specification. Available in colors. Any lengths from an inch to a mile!

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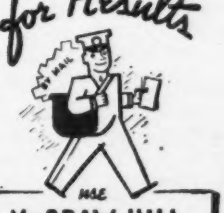

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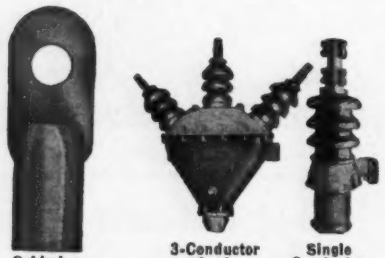

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BOOK REVIEWS

Electrical Technology For Beginners. By G. W. Stubbings. Published by E. & F. N. Spon, Ltd., London, England. 156 pages, illustrated. Price 6/6d.

A brief non-mathematical primer on circuits, apparatus, lighting measurements and testing.

Dictionary of Electrical Engineering. By G. W. Stubbings. Published by E. & F. N. Spon, Ltd., London, England. 219 pages, illustrated. Price 10/6d.

A glossary of some 850 terms and principles used familiarly by electrical engineers so prepared as to be explanatory and informative as contrasted with the stilted and academic phraseology of professional definitions. Where the subject (like synchronous motors) warrants it, a full page of discussion is presented.

Electric Wiring, Theory and Practice. By W. S. Ibbetson. Published by E. & F. N. Spon, Ltd., London, England. 263 pages, illustrated. Price 10 s. net.

This is an eighth edition revision brought out to reflect the latest changes in the British Standard Specifications and the I.E.E. regulations. Opening chapters deal with circuit principles and then the treatment of interior distribution systems and accessories and the techniques of approved installation are taken up.

The Electric Power Engineer's Handbook. By S. W. Ibbetson. Published by E. & F. N. Spon, Ltd., London, England. 295 pages, illustrated. Price 15 s. net.

Needs of industrial power installing and operating engineers are the evident objective in this elementary treatment of circuits, generators, converters, rectifiers, batteries, motors and the practicalities of their operation, testing and upkeep.

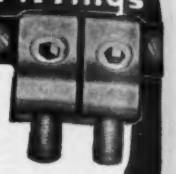
Circuit Analysis by Laboratory Methods. By C. E. Skroder and M. S. Helm. Published by Prentice-Hall, Inc., New York, N. Y. 288 pages, illustrated. Price $5.35.

Some 35 laboratory exercises in elementary circuit analysis are framed in formal textbook manner. First the tools in the form of protectors and instruments are treated and then the book takes up resistance measurement, motor and generator, Kirchhoff's laws, watt measurement, impedances, polyphase and reactive power. The authors are staff members at University of Illinois.

Nucleonics. Published by Progress Press, Washington, D. C. 38 pages, illustrated. Price $1.00.

Based on official material prepared under the auspices of the U. S. Navy, this tersely compiled "handbook" on fissionability starts with the molecule and atom and moves on to discuss nuclear structure and how it is subject to fission and transformations leading to energy release. Simplicity of expression is the aim of the compilers in their effort to render atomic energy understandable to citizens of better than average intelligence. En route there is the hypothesis accounting for solar energy and discussions of the cyclotron and Van de Graaf generators which laid the foundation for the mass production of the explosives now being redirected to power and therapeutic purposes. One page of intriguing interest should be the one that demonstrates that the nuclear reaction had to take place

Conductor Fittings



Cable Taps, Lugs Tees, Service Connectors, Grounding Clamps, Straight and Parallel Connectors, Elbows, etc., etc.

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ERIE, PA.

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Pioneers

● And specialists in designing and building outdoor meter boxes.

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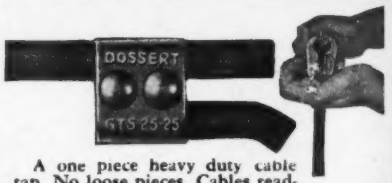

A one piece heavy duty cable tap. No loose pieces. Cables readily inserted from end or sides as illustrated. *For complete listing of Power connectors send for Catalog 45.*

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in one-billionth of a second to achieve Hiroshima explosiveness; there is a bit more light on the critical-mass question.

Industrial Carbon. By C. L. Mantell. Published by D. Van Nostrand Co., New York, N. Y. 472 pages, illustrated. Price $7.50.

Practically a third of the pages are devoted to specific electrical uses of carbon in the form of electrodes, brushes, arc lamp carbons, resistors, tube anodes, etc. Each of the chapters deals with the appropriate properties, preparation, fabrication and resulting characteristics in detailed, quantitative manner. Far from a descriptive treatment, the author has succeeded in compiling a comprehensive amount of authenticated information for reference purposes.

The other portions deal with diamond, graphite, lampblack, refractory liners and the physical and chemical properties of carbon in its various forms as well as the recognized analytical tests for purity and functional characteristics of carbon in its multifarious forms.

LETTER TO THE EDITOR

Power Factor Calculation

To the Eidtor of ELECTRICAL WORLD:

The article "Two Rotating Standards Determine Power Factor" by John Bowles (ELECTRICAL WORLD, August 17, 1946, page 90) is interesting, timely and requires reiteration to bring out its usefulness.

The formula on page 92 can be expressed directly in percent power factor as follows:

$$\text{Power Factor (percent)} = 50\sqrt{\frac{(1+R)^3}{1+R^3}}$$

where $R = W_1/W_2$ and $W_1 < W_2$;
or if desired the expression may be written:

$$\text{Power Factor (percent)} = 50\sqrt{\frac{(1+W_1/W_2)^3}{1+(W_1/W_2)^3}}$$

The writer has found either of the foregoing easily remembered after some 30 years of use.

Carrying the method further we can write:

$$\text{Total watts (or kw.)} = W_1 + W_2$$

$$\text{Vars (or kvar)} = \sqrt{3}\,(W_2 - W_1)$$

$$\text{Volt-amperes (or kva.)} = 2\sqrt{W_1^2 + W_2^2 - W_1W_2}$$

The advantages of the method are:

1. Accurate results.
2. Simplicity in application.
3. Values of more than 100 percent are never obtained as in the volt-ammeter-wattmeter method.

Even though the requirement for a balanced circuit is stressed, the method is accurate where some unbalance exists.

The use of this method as a demand indication does not seem to be sufficiently stressed.

C. O. von Dannenberg
Brooklyn 17, N. Y.

MATTHEWS DISCONNECTING SWITCHES

Available in ratings of 200, 400 and 600 amperes, 7500 volts. They have high dielectric values and are of the dead blade type. Swivel type hangers permit mounting of switch in convenient position for lineman. Large, high pressure, point type contacts and heavy copper blades assure cool operation at full rated load. Yoke type terminals confine strands of terminal wires. Bakelite doors securely latch in open or closed positions. Quick break blades to prevent burning of contacts can be supplied on the 200 and 400 ampere sizes.

Write for Bulletin 106

W. N. MATTHEWS CORP.
3722 FOREST PARK BLVD.
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NEW ADVERTISEMENTS received by 10 A. M., October 4th will appear in the October 12th issue subject to limitations of space available.

POSITIONS VACANT

ELECTRICAL APPARATUS Sales Engineer. Applications invited by Machinery Sales organization for young graduate Electrical Engineer preferably single, for sales and engineering position South America. Preferably familiar with GE products. Knowledge Spanish not necessary but asset. Mail full details, education and experience to Box 286, Church Street Annex, New York, N. Y.

AN EXPERIENCED technical trained man is wanted by a Southwest public utility system. This utility has an opening for a man with ability and training in the field of coordinated operation of plant. Should have an excellent working knowledge of system dispatching and power plant operation, transmission of power, relaying and communications. Write details about personal experience and employment record. P-358, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dunn Bldg., Buffalo 2, N. Y.

EXECUTIVE AND Technical Men—Since 1915 thousands have used our confidential personnel service with success in contacting employers for desirable positions. We handle all negotiations. Send experience record with inquiry. The National Business Bourse, 20 W. Jackson Blvd., Chicago 4, Ill.

POSITION WANTED

ELECTRICAL ENGINEER: 11 years experience designing and analyzing electrical systems. Desires position with public utility analyzing system for stability, relay applications and settings. PW-359, Electrical World, 68 Post Street, San Francisco 4, Cal.

SELLING OPPORTUNITY WANTED

FRENCH FIRM having good technicians and business agents seeks representation of all household electrical articles. Write Dumoulin, 15 Rue Ohmacht, Strasbourg, France.

DEVELOPMENT ENGINEER

Growing midwest manufacturing company needs electrical engineer for design and development work in protective equipment. The engineer should have ten or more years experience in the electrical transmission field. A knowledge of power line maintenance and construction is desirable. The position is permanent, salary good, and there is opportunity for advancement. Please forward photograph, and experience and education resume.

P-297, Electrical World
520 North Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEERING OPPORTUNITY

Electrical manufacturer of nationally known motor control and power distribution equipment is interviewing candidates for a student engineering course directed toward headquarters application and field engineering work of permanent nature and with excellent opportunity for advancement.

Men selected must have engineering degree, sales aptitude, intelligence, initiative and be within 21 - 30 year age bracket. Give full particulars.

ADDRESS —

P-357, Electrical World
520 North Michigan Ave., Chicago 11, Ill.

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ELECTRICAL ENGINEER

To design and layout new transmission lines and substations and to re-design present system for future growth.

Good starting salary for graduate electrical engineer with experience.

Applicants please state age, education, and experience record.

Personnel Director

New Jersey Power & Light Company
Dover, New Jersey

ELECTRICAL ESTIMATOR

Large engineering and construction organization desires Electrical Cost Estimator. Opportunity for man with substantial background of electrical engineering and estimating for modern steam plants, transmission lines and substations. Applicants state age, education, experience and salary.

P-281, Electrical World
330 West 42nd St., New York 18, N. Y.

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Experienced graduate engineer, capable complete design of high voltage transmission lines, including lightning protection, economic selection of voltage, conductors and structures, and preparation of estimates of cost, specifications and plans for installation. Qualifications and Experience Record should be submitted with letter of application.

P-332, Electrical World
330 West 42nd St., New Yoork 18, N. Y.

ELECTRICAL PROJECT ENGINEER

One (1) experienced graduate engineer, responsible charge electrical engineering and design of steam-electric and hydro-electric power plants and high voltage substations. Applicants please furnish personal data and Experience Record.

Box 122, Church St. Station P. O.
New York 6, N. Y.

UNDERGROUND ENGINEER

Graduate electrical engineer, with at least eight (8) years' experience in design of underground distribution and transmission systems. Applicants should be capable of selecting most suitable types of insulations and coverings for underground cables. Experience with underground and submarine cables above 33 kv. desirable. Please furnish Experience Record and personal data with application.

P-333, Electrical World
330 West 42nd St., New York 18, N. Y.

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Do you need competent men for your staff?

Are you seeking employment?

Or, are you looking for—or offering—a business opportunity of special interest to men in the industry served by this publication?

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